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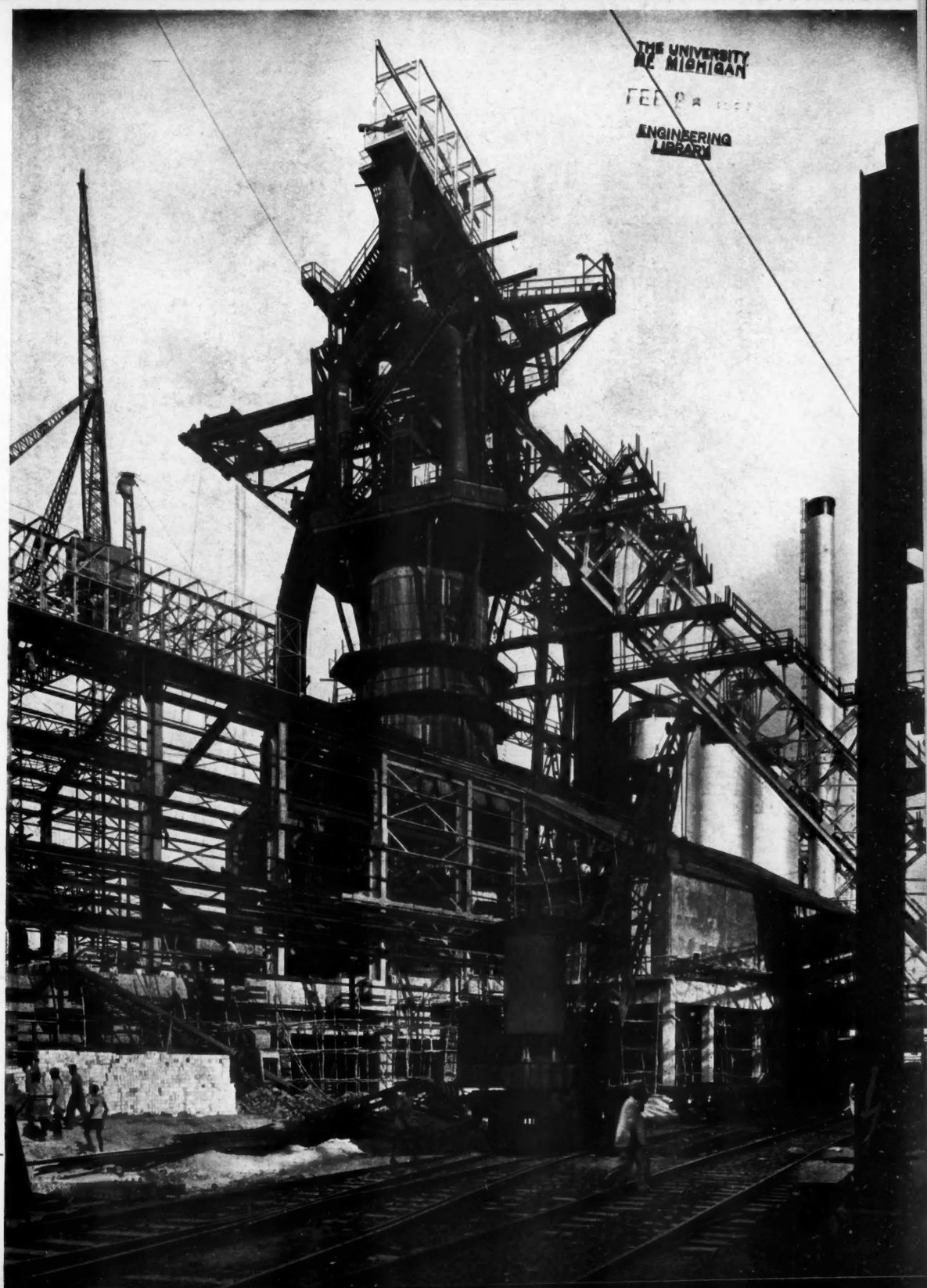

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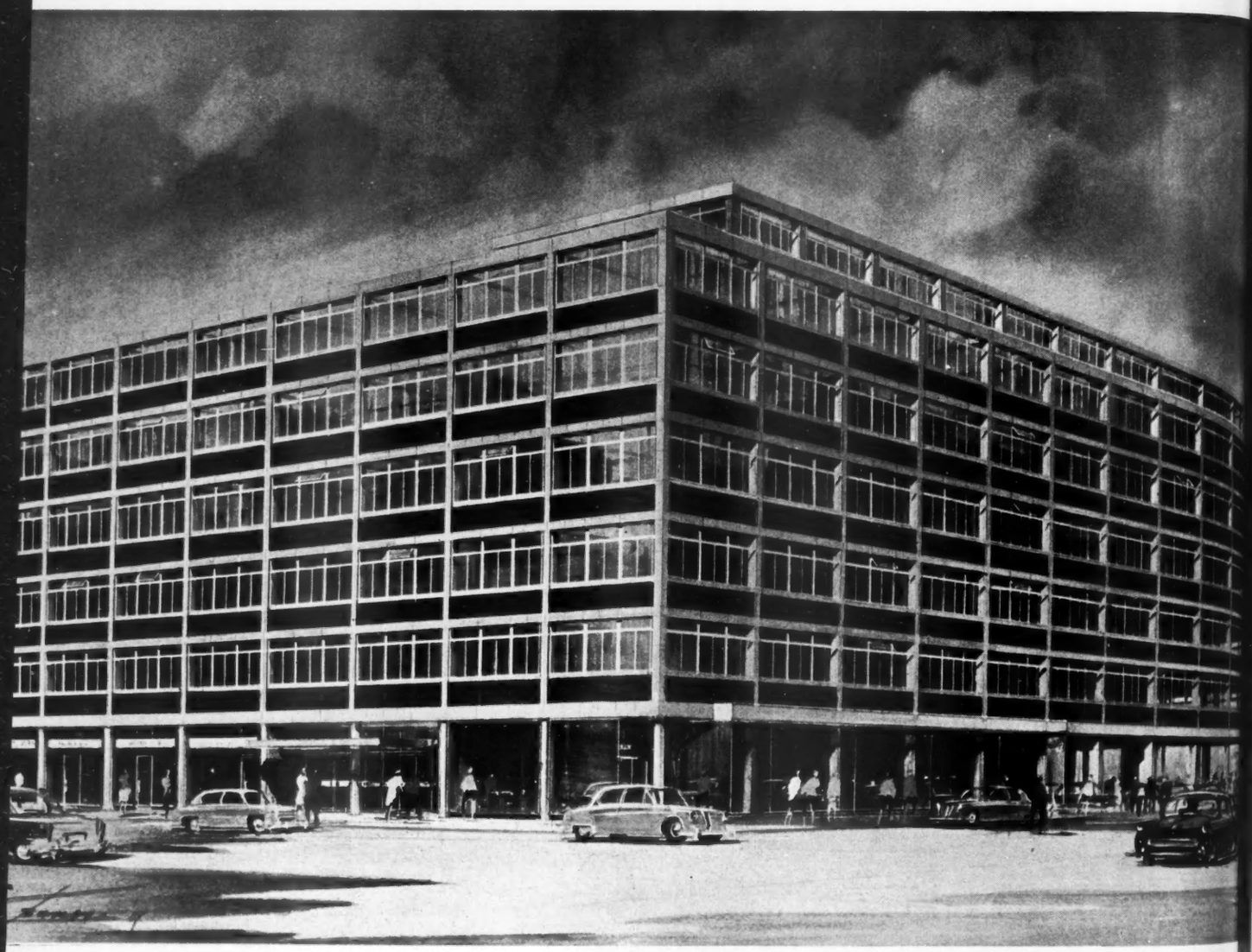

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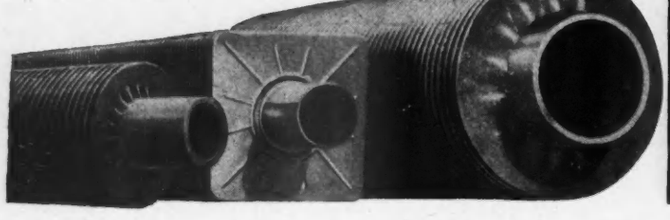

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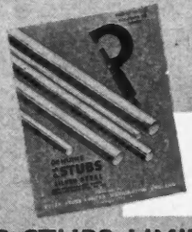

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ENGINEERING Impact

of Changes in the USA's Investment in Europe

SURVEYING United States private investment in Europe, Mr. Guy de Carmoy, who is the Inspector of Finances in France, finds that the total amount is not above 0·3 per cent of gross investment, or 1 per cent if loans and credits are included.

But its influence is out of all proportion to its size. Technical progress is stimulated because the investment tends to go into expanding and competitive industries, bringing in its train access to advanced patents and highly developed techniques. Companies not directly affected by the investment moves have to act swiftly with the introduction of improved products, with greater productivity and attention to costs in order to meet the new conditions.

Writing in the recently released winter number of the European Productivity Agency's international journal *European Productivity*, Mr. Carmoy makes the chilly assessment that Britain is receiving less capital from the United States in relation to the members of the European Economic Community than she was. But being an excellent "springboard" for exports to the Commonwealth and the European Free Trade Area, some investment in the UK will continue.

When it is borne in mind that, compared with Britain's 50 million, the European Common Market numbers above 200 million people, the rate of United States investment reckoned in terms of dollars per head is still very much higher in the United Kingdom.

Seeking High Earnings

What essentially attracts the foreign investor to place his money in an overseas country is the expectation of higher income, or of greater capital gain. The effect that can be expected to follow the higher rate of growth in Italy, France and Germany than in Britain for the greater part of the last decade is obvious enough.

It is a possibility that the new Kennedy régime in the United States will lead to a greater use of the high proportion of industrial capacity now standing unused, even to a reduction in the more than four million figure at which the national unemployment level has stayed for so long. But that is not to say that the United States will suddenly reverse its tendency to higher and higher production costs, or the movement by which more and more people move into service trades, particularly distribution.

But in the European Common Market the progressive moves towards common tariffs, the opportunity of the leading firms to establish production lines for a market numerically larger than the United States, are only part of the reasons for the expectation that productivity and the gross national products will go on rising in the next few years. Which is sufficient reason for the flow of American capital to continue, even to increase.

But the United States is not the only source of investment funds. From within the European Common Market there is the investment strength of Western Germany, created by her powerful trade balance. British companies have made their own moves into the promising European Common Market. If none of their individual moves have been as resounding as the £129 million American Ford investment involved in the take-over of the British owned shares in Ford's of Dagenham they still add up to a heavy programme, and the beginning of a considerable stake in the ECM.

EPA gives the following list of some UK firms moving into Europe.

Leyland Motors and Standard-Triumph International (now merged)—Benelux,
Metal Industries—France and Belgium,
Metal Box—Italy,
Lines Brothers—France and Belgium,
Wilmot Breedon—France,
Ether Langham Thomson—France,
Elliott Automation—France,
International Computors and Tabulators—Germany,
Ever Ready—France and Germany,
Pakamac and Holt Products—The Netherlands,
Dunlop—Extension in France,
Bowater—France, Germany, Italy,
Camp Bird—Germany.

For the future the advantage of outside investment in European, or British, industry is plain. As a stimulus to fresh thinking and design, and by introducing otherwise unavailable patents and products it can lead to great efficiency and better ability to compete.

In order not to be left behind in the race, it is necessary to further improve productivity and keep down costs. It also appears from the United Kingdom point of view, to be another reason for joining Europe's two parts into one even larger market.

Wanted: More Skilled Men and 6 per cent More Exports

The fact that the vacancies in British industry are largely for skilled men and that the unemployed are more often the unskilled has been noted on occasion in these columns. The Parliamentary Secretary to the Ministry of Labour, Mr. Peter Thomas, succeeded in startling the recent meeting of the National Production Advisory Council with his statement that in December for every unemployed skilled man in the engineering industries there were four vacancies.

At the same meeting, Mr. Selwyn Lloyd, the Chancellor of the Exchequer, described the shortage of labour in some industries as "almost desperate." Shortage of labour has been described by the economists of the OEEC as a factor likely to inhibit Britain's growth this year, but it is now more and more apparent that if production is to rise and if productivity is to improve sufficiently to keep costs down, or even reduce them, there must be much more training of skilled workers.

There is plenty of room for the smaller and medium sized firms to do better in taking on (and training) apprentices, permitting day release for their workers, and generally following the lead of the larger organisations. One of the customary answers on this difficult point has been the group apprenticeship scheme in which numbers of firms participate. Mr. Lewis Wright, the TUC's economic committee chairman, brought his up at the Advisory Council meeting. He met disagreement from Lord McCorquodale, President of the British Employers Confederation, who said schemes of this nature have not been very successful.

Mr. Selwyn Lloyd is a believer in the United Kingdom's ability to increase national production by 3 per cent each year. If this is not to run the country into balance of payments trouble it hrs to be matched with a 6 per cent rise in exports.

The connection between the amount and quality of industrial training and the national prosperity could scarcely be made clearer.

of a Three per cent Rise in 1961's Building

For the building industry 1960 was a year of activity at record levels. 1961 is expected to see an increase of 2 or perhaps 3 per cent in the work required. Since the labour force was fully employed in 1960 this means that the additional results will have to come from improved productivity.

On this point of productivity the National Federation of Building Trades Employers, whose annual report of earlier this week made the increased load forecast, is reasonably confident. The NFBTE believe that if the greater productivity reached last year can be matched by equal gains in this, then the higher output from the industry will be possible.

At the end of 1958, the Federation's index of work under construction (1955 = 100) stood at only 86. But by the third quarter of last year it had reached 101 and the official index of construction output (1954 = 100) had risen to 118.

For the industry's productivity to be significantly improved, attention needs to be given to further improvements in training. There is a link here with the profits of the firms that make up the industry. In relation to turnover, building firms' gross profits have been falling ever since 1955. So far as the Federation knows, tendering throughout 1960 was extremely keen. For profit margins to be falling, while prices of materials from cement and bricks to wood and roofing tiles have all been increasing, is a serious matter.

Profits and Efficiency

The Federation describes the results of the trend like this: "Low profit margins may appear at first sight to bring short-term advantages to the individual building owner, but, in the long run they are highly damaging to any industry. They weaken the ability of building firms to raise their standards, to develop training schemes, to replace and increase their plant, or to improve their management techniques."

As the NFBTE sees it, since low profits deprive companies of the funds for reinvestment, the effect will be to reduce efficiency and the chief sufferer will be the building client of the future.

At the same time that it is likely to be faced with the challenge of increasing calls on its capacity, the industry will be meeting the opportunity of taking into its ranks some of the rising number of school leavers. The Federation is awake to its chances. Its report says: "It is of vital importance not only to the building industry but to the country as a whole that the industry should, in the next few years, recruit considerably more boys for training for skilled jobs."

Attention is not concentrated solely on the school leavers. There is some lively thinking in the industry about the training of supervisory and management grades.

Rising levels of activity in building seem to be linked with increasing casualty figures.

Year	Total accidents	Fatal accidents
1957	14,568	156
1958	15,017	207
1959	15,410	169
1960 .. .. (first six months)	8,314	109

There are certainly a number of reasons that can be set against this "discouraging" trend. The buildings themselves get taller and taller, they are also increasingly complex. In addition there is said by the Federation to be a greater awareness among the small firms of the obligation to report all accidents where a man is away from work for three days or more.

From official publications the Federation notes that 40 per cent of all building accidents, and 50 per cent of the deaths occur on industrial construction, which employs only 13 per cent of the total labour force.

Accepting that the more distant prospect could be affected by the deterioration in the general economic position, the Federation bravely observes that it would be "unwise to dismiss as unduly optimistic" those who think the early summer will bring a forward movement in the economy.

and America Buys Japan's Engineering Products

Since the war the Japanese have reorganised their industry and overseas trading arrangements. In 1955 Japan's exports to America totalled $449 million and imports some $772 million worth of United States goods. By 1959 exports had increased by 2¼ times to $1,030 million and were practically in balance with Japan's imports from the United States. Most of this increase was made up of new products headed by machinery, including transistor radios, followed by cameras and binoculars.

The biggest single item imported from Japan was radio sets, mainly of the transistor type which the Japanese are now making so efficiently. The sets are selling both on quality and price. A Japanese six-transistor set costs only half the $50 to $60 a comparable American made set would sell for. Radio output has risen from 3½ million sets in 1957 to 8 million in 1959. Transistor sets are the main product of the Japanese radio industry and account for 90 per cent of overseas sales. So far Japanese television sets have made no great impact on the American market. Home demand has been very great and the surplus for export small.

The second largest item in Japan's export drive to the United States is sewing machines. Home demand in Japan is virtually saturated so that the pressure on imports is increasing steadily. The industry presents a problem to the Japanese authorities as about 90 per cent of the factories employ less than 300 workers. These small producers are all trying to sell their goods on the export market and competition is so fierce that the Government attempted to regulate it under the Light Machinery Export Promotion Law introduced in July, 1959.

Uses of Precious Metal Alloys in Brazing

Many operations which once entailed welding or mechanical assembly can now be replaced by brazing. Precious metal brazing alloys are particularly useful at high temperatures in vacuum.

A RANGE of special-purpose brazing alloys, available from the Baker Platinum Division of Engelhard Industries, includes certain of the established silver and gold alloys and also the recently developed palladium-containing alloys.

In general, these alloys offer three important advantages over conventional brazing materials: strength at high temperature; low vapour pressure; and the ability to join certain materials which cannot be brazed with conventional alloys. The following additional advantages are offered by the palladium-containing alloys: erosion of the parent metals is reduced to a minimum, thus facilitating the joining of thin sections; and it has been found possible to join metallised ceramics directly to low expansion alloys without nickel plating the ceramic.

Silver-Copper-Palladium.—These are particularly useful in all vacuum applications, including electronic valve construction. The alloys have excellent flowing and wetting properties and penetrate exceptionally well into the spaces being filled. Nevertheless, the bridging qualities are such that, when the design permits, clearances of up to 0·020 in may be filled successfully.

There is little attack on ferrous or nickel-containing alloys by palladium-containing brazing fillers. This is particularly advantageous when brazing thin materials, such as those used for honeycomb structures and heat exchanger parts.

Selection from the appropriate alloys in the range enables complicated components to be assembled by step brazing. Steps of approximately 50° C (liquidus temperature) from 800 to 1,100° C are available in the silver-copper-palladium group. The range may be extended by using other special-purpose alloys. The alloys do not form brittle compounds with most parent metals; hence, there is little danger of unexpected failures in service.

Stress corrosion cracking occurs with many of the conventional silver-containing brazing alloys when brazing nickel-iron alloys, for example in glass-to-metal seals. However, the presence of palladium in the silver-copper-palladium alloys has been found to inhibit this effect and to confer increased resistance to oxidation and other forms of corrosion. For effective inhibition of stress corrosion when brazing low expansion alloys, a palladium content of not less than 10 per cent is desirable. For this reason alloys 724, 725, 719 and 748 are particularly recommended for such applications.

Alloy	Constituents	Tensile strength, tons per sq. in	Elongation, per cent on 10 in	Hardness, DPN	Specific gravity at 20° C	Resistivity microhm/cm cube at 20° C	Liquidus temp., °C	Solidus temp., °C	Typical brazing temp., °C
179	Silver-copper	26	30	88	10·0	2·5	779	779	800
424	Gold-copper	30	17	250	17·2	14·2	889	889	910
429	,,	27	38	112	15·2	13·9	915	905	930
441	Gold-nickel	45	5	245	17·4	29·2	950	950	970
722	Silver-copper-palladium	29	23	90	10·1	3·9	810	807	815
723	,, ,, ,,	31	22	75	10·1	6·0	852	824	860
748	,, ,, ,,	32	25	140	10·3	9·9	898	876	905
724	,, ,, ,,	30	20	120	10·4	9·6	900	850	905
725	,, ,, ,,	33	15	185	10·5	14·3	950	901	955
718	,, ,, ,,	14	28	50	10·6	4·7	1,010	970	1,015
719	,, ,, ,,	22	30	85	9·4	15·0	1,090	1,080	1,095
279	Copper-palladium-nickel-manganese	40	35	135	9·0	52·5	1,105	1,060	1,110
2601	Silver-palladium-manganese	18	11	95	10·5	9·4	1,120	1,000	1,120
2602	,,	32	25	130	10·8	21·5	1,200	1,180	1,220
318	Nickel-manganese-palladium	53	7	330	8·4	18·1	1,120	1,120	1,125
288	Palladium-nickel	50	30	224	10·3	21·7	1,237	1,237	1,250

The comparatively low melting points of the silver-copper-palladium alloys have proved advantageous for brazing where the parent metals are susceptible to grain growth at higher brazing temperatures. Furthermore, it has been found possible to combine brazing with heat treatment.

Apart from their advantages when brazing conventional metals, other more difficult parent metals including cobalt-base alloys, Nimonic alloys, tungsten, molybdenum, zirconium and beryllium have been successfully brazed with silver-copper-palladium alloys.

Silver-Palladium-Manganese. — These alloys have excellent creep resistance at elevated temperatures and were originally developed to braze high temperature, creep-resistant metals such as tungsten, molybdenum, heat-resisting steels, and cobalt-base and nickel-base alloys.

Erosion of stainless steels and alloys of high nickel content is slight and these brazing alloys have been successfully employed for joining thin sections. This factor renders the alloys of particular value in the fabrication of heat exchangers. Due to the high brazing temperature, 2602 alloy is not recommended for certain nickel-base alloys such as the Nimonics.

Nickel-Manganese-Palladium.—318 alloy was developed as an alternative filler material to 2602 alloy. It has, however, a lower brazing temperature and higher shear strength combined with comparable stress life on joints tested at high temperatures. Applications for this alloy are found in brazing high temperature creep resistant metals such as tungsten, molybdenum, heat-resistant steels and cobalt and nickel-base alloys. 318 alloy is resistant to attack by molten

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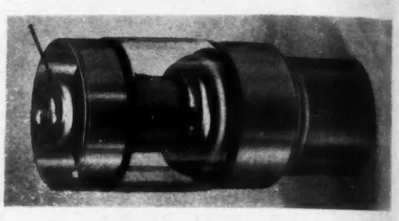
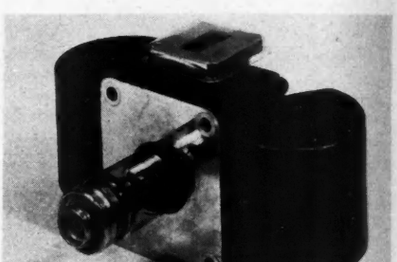
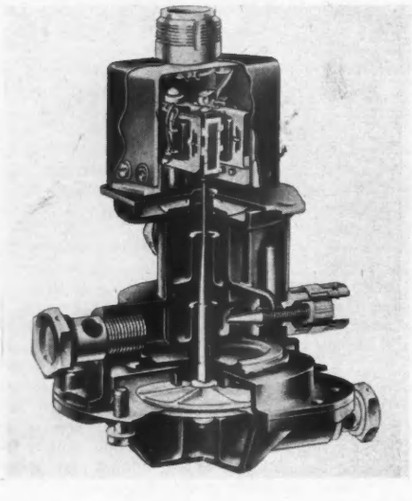


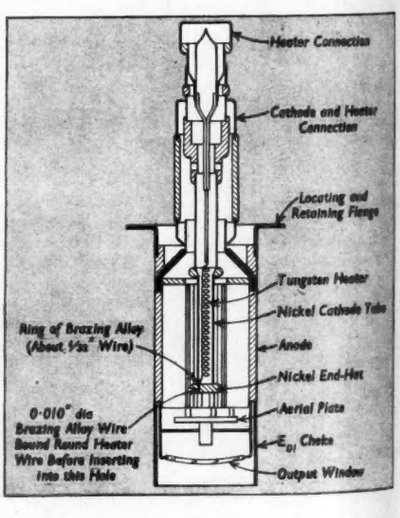
***Gold-Nickel.**—Ferranti use 441 alloy to join the molybdenum focus electrode to a molybdenum support tube in their Klystron amplifier. Brazing is carried out at 960° C in a hydrogen atmosphere by induction heating.*



***Gold-Copper.**—This is a Mullard JP9-250 fixed frequency, forced air-cooled, multi-cavity Magnetron. Gold-copper alloy is used for joining copper to copper, copper to Fernico (permanent magnet alloy), and Fernico to itself or nickel. This brazing alloy avoids arcing which can be a danger in such high voltage valves if there is any trace of metal vapour present.*



***Silver-Palladium-Manganese.**—This Microjet control unit made by H. N. Hobson will work in ambient temperatures of 250° C, measuring pressure ratios of gases. The hotter gas—say up-stream in a turbine—can be at 490° C. The diaphragm is in a gas pocket and is of glass cloth covered with silicone rubber. The nine die castings which form the body are in austenitic stainless steel, and are brazed together with 2601 alloy. This comes in the form of thin shims a few thousandths of an inch thick which are placed between surfaces to be brazed before the whole is put in a jig and heated in an electric muffle in an atmosphere of dry hydrogen. 2601 gives good strength at working temperatures and resists oxidation.*



***Palladium-Nickel.**—A section through a high power Boot Magnetron M566 made by English Electric Valve Company: 288 alloy is employed for brazing the nickel end-hat on to the nickel cathode, at the same time securing one end of the tungsten wire heater. Parts of this Magnetron operate at 800° C in high vacuum. Brazing is carried out by induction heating in an atmosphere of cracker gas.*

Continuing Brazing Alloys

alkali metals and thus is of particular interest in applications not only for air-cooled gas-turbines but for turbines cooled by liquid sodium. The alloy is of considerable interest for applications in the nuclear energy field owing to its freedom from silver and elements of high neutron capture cross-section.

As in the case of the silver-palladium-manganese alloys, the erosion of stainless steels and alloys of high nickel content is minimised, and 318 alloy is therefore particularly suitable for joining thin sections in the fabricating of heat exchangers.

Copper - Palladium - Nickel - Manganese.—279 alloy was one of the most recent to be developed and has found applications in the nuclear energy field. It is second only to 318 alloy in resistance to attack by the molten alkali metals. It is particularly suited to brazing stainless steel and nickel-base alloy components where the low degree of erosion encountered renders the alloy particularly suitable for joining thin sections, In common with 318 alloy the alloy is suitable for vacuum brazing but is available in a far wider range of sizes than the former alloy.

Palladium-Nickel.—288 alloy has the highest palladium content of any of the palladium-containing brazing alloys and better vacuum properties than any with comparable strength at high temperatures.

It has been used for brazing high melting point materials, such as tungsten and molybdenum for electronic applications. In this connection it may be employed as the first joint in a graded series thereby extending the range of steps available with the existing silver-copper-palladium alloys.

Thin sections of stainless steel may be brazed and application has also been found in brazing metallised ceramics and cermets and in the nuclear energy field.

Silver-Copper.—179 alloy is used widely in the electronic valve industry. The flowing and wetting properties are exceptionally good. Because 179 is a eutectic alloy with a single melting point, it is not suitable for bridging large clearances.

To some extent, 179 alloy is tending to be superseded by 722 alloy which shows certain important advantages, but for step brazing this silver-copper alloy provides a useful addition to the silver-copper-palladium alloys by extending the lower end of the melting point range. It will braze nearly all parent metals satisfactorily, but when stress corrosion cracking is to be combated, the silver-copper-palladium alloys will give improved results. Similarly, silver-copper-palladium alloys are to be preferred for brazing parent metals which tend to form brittle compounds.

Gold-copper.—Gold-copper alloys have outstandingly good vacuum properties and, in this respect, are second only to palladium-nickel (288) alloy and to gold-nickel (441). 424 gold-copper alloy, although not a true eutectic, has a single melting point and has the higher gold content; 429 alloy possesses a plastic range, and hence is more tolerant to joint clearance.

Both alloys exhibit extremely good resistance to all forms of corrosion and may be employed with a wide range of parent metals. The gold-copper alloys are finding a wide field of application where their relatively high cost is outweighed by their exceptional properties.

Gold-Nickel.—441 alloy has the lowest possible melting point of any alloy in the gold-nickel series, and together with 288 alloy, has the best vacuum properties of any of the special-purpose brazing alloys described. Hence, it finds applications where the highest vacua are required. Due to its high gold content, 441 alloy provides exceptionally high resistance to all forms of corrosion. In addition to its exceptionally low vapour pressure, this alloy also possesses greater mechanical strength than the gold-copper alloys.

Engelhard Industries Limited, 52 High Holborn, London, WC1.

Sound Absorbing Materials

The NPL have done a good job in collecting information on the relative performance of sound absorbing materials. Thus the heart of a new book now published for DSIR entitled *Sound Absorbing Materials* (3*s*) consists of tables of absorption coefficients of over three hundred materials measured at the Laboratory. But the book is not quite so useful as it could be—it lacks the down-to-earth information on who the makers are and their addresses.

In the words of the introduction " the measurements cover most of the absorbents used in this country, and the purpose of this booklet is to make the information obtained generally available to users and manufacturers, and to architects and others concerned with the application of sound absorbents." For the man who has already decided on which insulation to use, this will tell him how it compares with others, but it will be a good architect or builders' merchant who will be able to supply any one of 300 materials or even to put his finger conveniently on where to go for supplies. Scientifically the book appears sound, and basic coefficients for at least six frequencies in the audible range are quoted for each material, together with simple formulae for calculating how long it will take for a sound in a room to die away to one-millionth of its initial value. The book is so near being of direct interest to the trade that it's a pity the NPL didn't decide to consider it completely from the angle of what such readers would want.

DSIR, 5-11 Regent Street, London, SW1.

Neoprene Soles withstand Oil and 150° C

Industrial safety boots are expected to stand up to plenty of heavy wear and tear but not, as a rule, to temperatures as high as 150° C. This was the problem facing a large British cable making concern, solved by their using neoprene synthetic rubber.

During manufacture of mineral insulated cable it is annealed in a roller hearth furnace. On leaving this furnace, the charges of cable, at about 150° C, pass directly on to a marshalling area. Lengths of hot cable are then rolled across the area and stacked, with the aid of the men's boots. Not only do the soles of the boots come into contact with the hot cable, they also pick up a good deal of oil and grease from the surrounding floor area.

Previous experience with leather soled boots had shown them to have a life of only a few hours in this work. Natural rubber soles were an improvement, but only lasted for three weeks at the maximum. Finally, neoprene, with its well-known heat and oil resistant properties, was used as the soling material. The original order was over 12 months' ago. There have been no complaints from the users, who have since re-ordered.

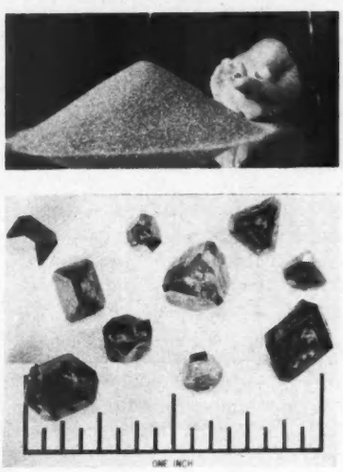
Soles and heels for these industrial safety boots are moulded from a neoprene compound containing about 50 per cent carbon black. Each sole weighs about 1 lb. More than 1,500 pairs of these soles and heels for work boots and shoes have been moulded during the last 12 months for ultimate use in heavy industry where only neoprene can withstand the conditions of heat, oil and chemicals. Such footwear—manufactured to BS 1870 : Pt. 1 : 1956 and BS 953 : 1952, Grade 1—is said by Du Pont to be finding increasing use in foundries, gasworks, engineering shops and glassworks.

Soles and heels: Bank Bridge Rubber Company Limited, Clayton, Manchester 11.
Safety boots: Bondsman Footwear Limited, Greengate Mill, Sandywell, Manchester, 3.
Raw neoprne: Du Pont Company (UK) Limited, 76 Jermyn Street, London, SW1.

Carat-Size Man-Made Diamonds

There has been a lot of talk about the impact that man-made diamonds may have if they can be produced cheaply in large quantities. General Electric, in the United States, started making diamonds in commercial quantities just over two years ago, and this illustration, if nothing else, supports their claim to have made millions of carats of industrial diamonds since that time.

Supported on the research man's finger is a



carat-size diamond made recently by this company, and below are shown some comparable ones in close-up. These large diamonds are dark in colour and are said to be not yet sufficiently strong for industrial application.

General Electric Research Laboratory, Schenectady, New York, USA.

Low Hydrogen and Stainless Electrodes

EutecTrode 66, made by Eutectic Welding Alloys has been developed for assembling and overlaying, for fabricating and repairing steels up to 38 tons per sq. in tensile strength. It is said to produce tough and crack-proof joints of great strength for such steels as carbon steels with up to 0·4 per cent carbon, also for low alloyed manganese-steels, chromium-steels, molybdenum-steels and chromium-molybdenum-steels. The makers say it is suitable for malleable cast iron, as well as for the steel side of plated steel sheet and padding prior to applying hard overlays. Good impact strength is retained even below freezing point.

Another new electrode, Super Stainees, has been developed by the English Electric Company with the aim of cutting the cost of welding stainless steel. In depositing up to 50 per cent more metal than normal—it has a coating containing metal powder—it is said to have the advantages of iron powder electrodes.

Eutectic Welding Alloys Company Limited, Faggs Road, Feltham, Middlesex.
English Electric Company Limited, Strand, London, WC2.

Plain Words

By Capricorn

BIG issues catch the eye; small ones are overlooked or passed over with a smile. How often I have given my complete attention to solving some formidable problem—and tripped up on a little one. Take tea, for example. Or would you prefer coffee?

I have long thought that my day was really built around elevenses and the afternoon pause for tea. Whether in my office or travelling I have considered it the mark of civilisation that coffee or tea should be produced for my convenience in the middle of the morning and at mid-afternoon.

I was early convinced during the war that the allies would win; they had our imperturbable backbone of tea drinkers on their side. We made the battlefield a commonplace by persisting in our everyday habits, and also recognised that war did not excuse us from considering minor human needs and whims.

I noticed that although the officer's mess might from time to time descend into chaos and be able to produce nothing but the mess accounts, the sergeants' mess was never without tea—strong, harsh stuff, always on the brew for the glory of British arms and the confounding of the King's enemies.

Now management and science alike have confirmed that I am right, that this tea business is no frivolous affair. Whatever may happen to productivity, vertical take-off or nuclear fusion, they can all wait for the tea break. I was once told by the chairman of a large public company making cars that if they had foreseen the importance of the tea break, they would have built tea pipes into the structure of the works, along with the escalator shafts. He may have thought that he was being grimly funny. He wasn't. He was just fifteen years in advance of his time.

We now know that the success of a new wage agreement in the building industry (higher wages for site workers next October) hangs on whether the men will accept the new arrangement about tea breaks. Automatic elevators to carry tea urns have been built into the new Shell building on the South Bank of the Thames.

So there it is. Great trees do from little acorns grow. The Indian Mutiny started with an argument about the kind of fat used for greasing cartridges.

The trivia of daily routine affect us much more than we think. In industry big issues call for big decisions. But if we then neglect the little ones (for little they may seem before they have developed) the cost may cripple us. The mote can blind as cruelly as the beam. Human idiosyncracy may prove as powerful in industry as it was in war.

By the nineteen nineties, I shall probably require my cup of tea in the pleasant atmosphere of a roof garden or salon; I shall want a shave at about four-thirty and a nap after lunch. I trust these simple needs will be provided for.

Letters to the Editor

Employment and Training of Foremen

SIR, First may I offer my congratulations to ENGINEERING for bringing about such a large and representative assembly of those concerned with the employment and training of foremen.

If I may contradict the proverb, the strength of the gathering was, I believe, in its diversity—senior people from sales and production, training and education officers, and a few representatives of technical colleges. The training problems of the foreman are discussed often enough by only two of those three, but, in my experience, not sufficiently by all three of those "orders" together.

It will be a loss to the engineering industry if the impetus given to foreman training by the survey and conference is allowed to run down. That is not an uncommon occurrence. A correspondence in *The Times* about a recent conference on management development in small firms made this point rather forcefully.

Time guillotined our discussions so that there were still a good many questions on the floor when we adjourned. The proposal for a National College was, perhaps, the biggest, but I would myself have liked to hear more about the age and stage for supervisory training. There were those who looked to selection at an early age and supervisory training as a logical extension of technical training. There were others whose thinking seemed to assume a far later age of entry upon supervisory duties. There was also the important point made by Mr. R. Coverdale that external training is not just a convenient substitute for internal training.

I mention these three questions as outstanding matters which would benefit from a more continuous examination than is possible in a conference and as matters which would benefit from the "three-order" approach typical of the meeting on 25 January—line managers, training officers and college teachers.

Could we not have a liaison committee which would help to keep the issue "on the boil"?

Yours faithfully,

JOHN DAVISON.

Brooklands County Technical College,
Weybridge.
31 January, 1961.

Window in a Hurricane

SIR, No doubt many other engineers and architects have been as amazed as I was at the eulogy given to the Idlewild terminal window in your article entitled "Largest Glass Window Defies Hurricane" (ENGNG., 23 Dec. '60, p. 855).

The winds recently experienced at Idlewild are quite common in this country, and it is my considered opinion that if glazed areas are not capable of withstanding the pressures mentioned in your article, then there is little point in erecting them. The wind forces mentioned, Force 8 gusting to Force 10, were, in fact, almost exactly those prevailing over the whole of the United Kingdom during Christmas week.

In this country, we have very many glazed areas having a continuous area in excess of 7,000 sq. ft exposed to higher wind speeds than the 58 mph quoted. It is true that these may not be stained glass, but then, the construction methods used are considerably simpler and cheaper than those used at Idlewild. From the illustration accompanying your article, it is apparent that the separate panels are relatively small, being approximately 3 ft by 2 ft 6 in, which is borne out by the number quoted (936); this should, in fact, make for ease in obtaining a stable glazed area.

I have personal knowledge of numerous larger glazed areas, and would instance particular continuous areas of over 12,000 sq. ft and 19,200 sq. ft, respectively. These are both made up of individual panels some 6 ft by 2 ft, mounted, in a perfectly conventional manner, direct in alloy glazing bars supported by glazing rails. These areas are actually designed to withstand gusts up to 120 mph, which I am sure you must admit make the Idlewild figures seem small in comparison. I might add that one of these areas is 740 ft long.

In conclusion, I would stress that the article could be confusing to anyone not fully acquainted with the facts. Not only does the article imply facts which are patently false, but it also tends to lend prestige which is entirely unwarranted, as I hope I have shown above. Although no one would gainsay the fury of "Hurricane Donna," that fury had been largely dissipated by the time Donna had progressed to Idlewild.

The wind force experienced there, on 12 September, was only fresh gale gusting to whole gale and, under no circumstances, can the glazed area be said to have "defied a hurricane." To have done so, winds in excess of 73 mph would have had to be observed.

Your faithfully,

F. H. POTTER.

Burnham-on-Sea,
Somerset.
2 February, 1961.

Market for Typewriters

SIR, You stated in your Outlook 1961 article on "Data Processing and Business Equipment" (ENGNG., 20 Jan. '61, p. 120) that "British Olivetti . . . has not made as much progress in Britain as it has in its other foreign markets."

We take exception to this as it is not backed by any factual information and it suggests, by implication, that our company is not particularly successful in this country. This is far from the truth. We manufacture standard and portable typewriters in Glasgow, and among the British manufacturers we have one of the biggest shares of the home market.

Yours faithfully,

G. FEI,
Managing Director.

British Olivetti Limited,
London, W1.
6 February, 1961.

Technical College Libraries

SIR, I very nearly wrote to tell Mr. Frank Smith (ENGNG., 13 Jan. '61, p. 66) how we "poor devils" in technical colleges got on along the same lines as your previous correspondents (20 Jan. '61, p. 92; and 27 Jan. '61, p. 137).

On reflection, however, I feel inclined to support him (as a fan of Frankie's I'm biased anyway)—his terminology is reasonably accurate for a start. We, too, use inter-library cooperation to a great degree and also get our 95 per cent successes—this is satisfactory as an achievement but is it strictly desirable? It must cost something like 15*s* to borrow one reference journal and this is only one aspect of a very large problem and probably not very relevant at that.

Mr. Smith touches on the crux of the problem when he asks what came out of the Aslib Conference on Technical College Libraries. Some seeds were sown—on obviously fertile and prepared soil—but, even now, I think it to be generally true that the potential users of a college library are not aware of what that library can do for them. The college librarians have to educate them—with inadequate finances, stock, staff and accommodation in many (most?) cases. This inter-library loaning is one of the major items in our repertoire in this task.

It is very interesting to see this correspondence in an engineering journal because it is my experience that the engineering staffs of technical colleges are the least informed and instructed in the value and use of a library. (Inter-library loan records tend to support this). Are engineers taught to use libraries? Do they not have time?

Do they not need them to the same extent as scientists? Perhaps Mr. Smith knows the answers or has a different experience.

Yours faithfully,

J. H. LAMBLE,
Librarian.

Bristol College of Science and Technology,
Bristol 7.
30 January, 1961.

Mixing Gases

SIR, Dr. P. Chambadal, in his article on "Mixing Gases and Gibbs' Paradox" (ENGNG., 16 Sept. '60, p. 398) obtained an expression

$$\Delta S = \frac{R}{J}\left(n_1 \ln \frac{p}{p_1} + n_2 \ln \frac{p}{p_2}\right)$$

where ΔS is "the total increase in entropy."

In his recent letter (23 Dec. '60, p. 848), he now states that there is no increase and asks me to show "without making use of permeable membranes" that there is a decrease of available energy corresponding to an increase of entropy. This is pointless and further emphasises the ambiguity of Dr. Chambadal's statements. Any textbook, including *Theory of Heat*, by Max Planck, gives the above expression for ΔS, and space does not permit the reproduction of yet another proof.

Much of Dr. Chambadal's argument seems to be based on a statement to the effect that the available energy of a mixture of gases is equal to the available energy of the constituent gases before mixing. (His proof in his article, under the heading "Interpretation," is faulty because he should have written internal energy (U) for enthalpy (H), a fact pointed out by Dr. Boris N. Cole (7 Oct. '60, p. 468)). This means that, if we evaluate the available energy quantities before and after mixing, we get the same value. However, the calculations do not tell us anything about the mixing, which we treat separately. I suggested (2 Dec. '60, p. 745) that Dr. Chambadal would violate the Second Law if he believed that the entropy remained constant during mixing, although he did not agree with me.

Let us suppose that the entropy remains constant when two gases mix and that there is no exchange of heat or work with the surroundings. Thermodynamically, this means that a reversible change has occurred and that we can recover the initial condition (two separate gases) from the final condition (the mixture) without introducing any change in the surroundings. We set up now a reversible mixing device, using permeable membranes, and allow the two gases to mix while producing work. The mixture, which has supposedly the same entropy as the separated gases, can be separated reversibly without external work and the original gases are reconstituted. Assuming that the gases are all at the temperature of the surroundings we have an arrangement which produces work from a constant temperature source—a perpetual motion machine of the second kind, which is denied to us by the Second Law.

We may look at the problem in yet another way which shows in very simple terms the essence of the problem. We have a room in which we can demonstrate both theoretically and experimentally the energy available in a given quantity of substance. The demonstrator enters the room with two vessels containing different gases at the same temperature and pressure and he is able to show that each gas can be made to deliver a certain maximum amount of work, the available energy. The demonstrator leaves the room with the gases in their original condition and mixes them. He then returns to the room and shows that the available energy of the mixture equals the total available energy which he obtained in his first demonstration. So far so good, but can he infer that since the available energy has not decreased due to mixing there is no increase in entropy? His experiments tell us nothing about the mixing, which he has carried out where we could not see him, but the Universe sees him and the usual toll in the form of an entropy increase is exacted.

Gibbs' paradox has been examined by Bridgman at some length and the conclusion then and now is that, if the gases can be distinguished statistically, the entropy increases. If the gases are the same we cannot speak of mixing since this is without meaning and there is no increase in entropy.

If Dr. Chambadal is correct when he asserts that there is no increase in entropy when two different gases mix I can only say that I stand in good company. If Dr. Chambadal is wrong then the other conclusions he reaches are as erroneous as his analysis of the mixing process.

Yours faithfully,

E. A. BRUGES.

Mechanical Engineering Research Annexe,
Glasgow University.
31 January, 1961.

Finding the Ideal Site

SIR, Professor W. E. Howland, in his recent letter (ENGNG., 6 Jan. '61, p. 4) commenting on the article "The Ideal Site as a Point of Equilibrium," by Jack I. Hanania, Khalil M. Malouf and Ivan A. Rubinsky (12 Aug. '60, p. 210) mentioned two references on the subject.

In the article referred to above, much earlier authors have been mentioned. The following are more complete references:

Gabriel Lamé, well-known by his work on the theory of elasticity. His article referred to was concerning the reduction of the problem of location to the problem of equilibrium. This article was published in the *Journal des Voies des Communications*, 1827, St. Petersburg.

The other reference includes the names of Lawngard and Vorgeimer mentioned in connection with water distribution. Their article was published in *Zeitsher d. Vereines Deitsher Ingenieure*, 1890, p. 679.

The method of "Mechanical Analogy Model" was used in the analogous, but more complicated, problem of the Theory of Errors by one of the authors of the article (I. Rubinsky) and described in "Analogies Méchaniques dans la Résolution des Problems de Géodesie," *Journal des Géomètres et Experts Français*, No. 125, March, 1931, p. 139.

Yours faithfully,

I. RUBINSKY,
Emeritus Professor of Research.

Faculty of Engineering,
American University of Beirut,
Beirut, Lebanon.
31 January, 1961.

Events in Advance

Welding Problems in the Shipbuilding Industry

OFFERS of papers will still be considered by the organisers of the Joint Symposium on Welding in Shipbuilding, provided that such offers are made promptly. In the main, however, it is understood that the programme for the symposium is now largely completed.

A variety of papers have already been offered and, of these, no fewer than 18 had been definitely accepted before the end of last year. These papers cover many aspects of the design of welded ships' hulls, including the use of high-yield-point steels; aspects of construction, including several papers on the layout of ships and the handling of materials; together with others on the welding of aluminium alloys. Also noted as having been accepted are a number of papers on the non-destructive testing of welded joints and on the training and testing of ship welders.

There are signs that the symposium is likely to assume a definite international aspect, contributions having been promised from Belgium, Denmark, Holland, Italy and Sweden. It is also expected that others will be forthcoming from Germany, Japan and the United States.

The symposium will be held in London in October/November next and is being sponsored by the Royal Institution of Naval Architects, the Institute of Welding, the North East Coast Institution of Engineers and Shipbuilders, and the Institution of Engineers and Shipbuilders in Scotland. Further information may be obtained from the headquarters of any of the foregoing engineering societies, or by communicating with the organising committee, c/o the Institute of Welding, 54 Princes Gate, South Kensington, London, SW7 (telephone: KNIghtsbridge 8556).

Exhibitions and Conferences

Royal Ulster Agricultural Society, 94th Annual Show and Industrial Exhibition.—Wed., 24 May, to Sat., 27 May, at Balmoral Show Grounds, Belfast. Organised by the Royal Ulster Agricultural Society, The King's Hall, Belfast, Northern Ireland. Tel. Belfast 665225.

Aeronautical Exhibition, International.—Fri., 26 May, to Sun., 4 June, in Paris. Organised by the Union Syndicale des Industries Aéronautiques, 6 Rue Galilée, Paris, 16e.

Luxemburg International Fair, 13th.—Fri., 26 May, to Mon., 5 June, in Luxemburg. Agents: Empson and Turner Ltd., Thorn House, Upper St. Martin's Lane, London, WC2. Tel. TEMple Bar 9081.

Mediterranean Fair, 16th.—Sat., 27 May, to Sun., 11 June, at Palermo. Agents: Specialised Exhibitions Ltd., 22 Half Moon Street, London, W1. Tel. GROsvenor 4503.

Institution of Electrical Engineers, Summer Meeting.—Mon., 29 May, to Fri., 2 June, in London. Offices of the Institution: Savoy Place, Victoria Embankment, London, WC2. Tel. COVent Garden 1871.

Photo Fair, International.—Mon., 29 May, to Sat., 3 June, at Olympia, London, W14. Apply to British Organisers Ltd., 52 Grafton Street, London, W1. Tel. EUSton 7930.

Commonwealth Technical Training Week.—Mon., 29 May, to Sun., 4 June. Apply to the secretary: Mr. C. B. McAlpine, C.B.E., City and Guilds of London Institute, 76 Portland Place, London, W1.

Radio and Electronic Component Show, 17th.—Tues., 30 May, to Fri., 2 June, at Olympia, London, W14. Organised by the Radio and Electronic Component Manufacturers' Federation, 21 Tothill Street, London, SW1. Tel. ABBey 4226.

Physics in Surface Coatings, Biennial Conference.—Tues., 30 May, to Sat., 3 June, at Torquay. Organised by the Oil and Colour Chemists' Association, Wax Chandlers' Hall, Gresham Street, London, EC2. Tel. MONarch 1439.

Bath and West Agricultural Show.—Wed., 31 May, to Sat., 3 June, at Ashton Park, Bristol. Organised by the Bath and West and Southern Counties Society, 3 Pierrepoint Street, Bath. Tel. Bath 3010.

Handicrafts and Trade Fair, 13th International.—Wed., 31 May, to Sun., 11 June, at the Exhibition Grounds, Theresienhöhe, Munich. Exhibition offices: 14 Theresienhöhe, Munich, Germany. United Kingdom inquiries should be sent to Mr. Neven du Mont, 123 Pall Mall, London, SW1. Tel. WHItehall 8211.

Helsinborg International Trade Fair (EXPO-ORESUND).—Wed., 31 May, to Sun., 11 June, in Helsinborg. Agents: Continental Express Ltd., Green Arbour House, Old Bailey, London, EC4. Tel. CITy 3243.

Electronic Engineering: Conference on Components and Materials Used in.—Mon., 12 June, to Sat., 17 June, at the Central Hall, London, SW1. Sponsored by the Electronics and Communications Section and the Measurement and Control Section of the Institution of Electrical Engineers. Apply to the secretary, Institution of Electrical Engineers, Savoy Place, Victoria Embankment, London, WC2. Tel. COVent Garden 1871.

Whole Body Counting, Symposium (Effects of Radiation).—Tues., 13 June, to Fri., 16 June, in Vienna. Apply to the International Atomic Energy Agency, Kaerntnerring, Vienna 1, Austria.

Aerospace Sciences, Combined National Technical Meeting on.—Tues., 13 June, to Fri., 16 June, at the Hotel Ambassador, Los Angeles, California, USA. Organised jointly by the American Rocket Society; and the Institute of Aerospace Sciences, 2 East 64th Street, New York 21, USA.

Events in Advance

Building and Public Works Exhibition.—Wed., 14 June, to Sat., 24 June, at Castle Bromwich, Birmingham. Supported by the Midland Federation of Building Trades Employers. Official organiser: Mr. J. Sandler, 20 John Street, Sunderland. Tel. Sunderland 58939.

Constructional Equipment Exhibition, International.—Thurs., 15 June, to Sat., 24 June, at the Crystal Palace, London, SE19. Organised by the Construction Equipment Exhibitions Ltd., Drury House, Russell Street, London, WC2. Tel. TEMple Bar 3422.

Nuclear and Electronic Congress and Exhibition, Eighth.—Thurs., 15 June, to Thurs., 29 June, in Rome. Applications in the United Kingdom should be made to Fairs and Exhibitions Ltd., 2 Dunraven Street, Park Lane, London, W1. Tel. HYDe Park 5421.

Plastics Exhibition, International (Europlastica).—Fri., 16 June, to Sun., 25 June, at Ghent. Under the patronage of the Belgian Government. Organised, in collaboration with the Belgian Federation of Chemical Industries, the Federation of Manufacturers of the Metal Goods Industry (FABRIMETAL) and the Belgian Plastics Syndicate, by Europlastica, Palais des Floralies, Ghent, Belgium. United Kingdom agent: Mr. Neven du Mont, 123 Pall Mall, London, SW1. Tel. WHItehall 8211.

Meetings and Papers

British Institution of Radio Engineers

LONDON
Television Group. Inaugural address by L. H. Bedford. London School of Hygiene and Tropical Medicine, Keppel Street, WC1. Wed., 1 Mar., 5.30 p.m.*

CARDIFF
"Radio and Electronics Industry in South Wales": discussion to be opened by N. Hughes, C. T. Lamping, D. R. Samuel and A. J. Shapland. South Wales Section. Welsh College of Advanced Technology, Cardiff. Wed., 8 Mar., 6.30 p.m.

EDINBURGH
"High-Speed Pulse Techniques," by E. Wolfendale. Scottish Section. Department of Natural Philosophy, The University, Drummond Street, Edinburgh. Wed., 8 Mar., 7 p.m.

GLASGOW
"High-Speed Pulse Techniques," by E. Wolfendale. Scottish Section. Institution of Engineers and Shipbuilders in Scotland, 39 Elmbank Crescent, Glasgow, C2. Thurs., 9 Mar., 7 p.m.

Chemical Society

ABERYSTWYTH
"Polymer Kinetics," by Dr. T. T. Jones. Aberystwyth Branch. Edward Davies Chemical Laboratories, University College, Aberystwyth. Thurs., 2 Mar., 5 p.m.

MANCHESTER
"Some Problems in the Chemistry of Phosphorus," by Dr. S. H. Pollard. Manchester Branch. Room F1, College of Science and Technology, Manchester. Thurs., 9 Mar., 4.30 p.m.

NEWCASTLE UPON TYNE
"Some Reflections on the Detergent Industry," by Dr. A. Koebner. Newcastle upon Tyne Branch. Chemistry Department, King's College, Newcastle upon Tyne. Fri., 10 Mar., 5.30 p.m.

East Midlands Metallurgical Society

NOTTINGHAM
"The Metallurgy of the Steam Turbine," by Dr. L. E. Benson. Faculty of Applied Science, Clifton Boulevard, The University, Nottingham. Thurs., 9 Mar., 7.30 p.m.

Illuminating Engineering Society

BLACKPOOL
"Blackpool Illuminations," by H. Carpenter. Manchester Centre. Illuminations and Electrical Services Department, Rigby Road, Blackpool. Thurs., 9 Mar., 2.30 p.m.

EDINBURGH
"Twenty Five Years of Stage Lighting," by F. P. Bentham. Edinburgh Centre. YMCA, 14 South St. Andrew Street, Edinburgh. Wed., 1 Mar., 6.15 p.m.

GLASGOW
"Twenty Five Years of Stage Lighting," by F. P. Bentham. Annual General Meeting. Glasgow Centre. British Lighting Council, 29 St. Vincent Place, Glasgow. Thurs., 2 Mar., 6.30 p.m.

NEWCASTLE UPON TYNE
"Lighting and Other Things in Moscow and Leningrad," by A. G. Penny. Newcastle upon Tyne Centre. Percy Building, King's College, Queen Victoria Road, Newcastle upon Tyne 1. Wed., 1 Mar., 6.15 p.m.

Institute of Metals

LONDON
"Progress in the Electron Theory of Metals," by Dr. J. A. Catterall. London Local Section. Thurs., 2 Mar., 6.30 p.m.*

OXFORD
"Novel Methods of Forming Metals," by Dr. J. F. Wallace. Oxford Local Section. Cadena Café, Cornmarket Street, Oxford. Tues., 7 Mar., 7.15 p.m.

SWANSEA
"Fracture of Metals," by Dr. K. E. Puttick. South Wales Local Section. Metallurgy Department, University College, Singleton Park, Swansea. Tues., 7 Mar., 6.30 p.m.*

Institute of Petroleum

LONDON
"Low-Cost Road Surfacings of Gravel Roads," by T. L. Les, G. P. Richard, P. J. Way and K. G. Latham. Wed., 1 Mar., 5.30 p.m.*

Institute of Physics and the Physical Society and the Institute of Refrigeration

LONDON
"Problems of Thermal Insulation and Their Solution": a symposium. Institute of Marine Engineers, 76 Mark Lane, EC3. Thurs., 2 Mar., 2 p.m.

Institute of Road Transport Engineers

BRISTOL
"Development of the Hovercraft," by R. Stanton Jones. Western Centre. Royal Hotel, Bristol. Thurs., 2 Mar., 7 p.m.

CARDIFF
"Servicing of Electrical Equipment," by J. H. Stoneman. South Wales Centre. South Wales Institute of Engineers, Park Place, Cardiff. Fri., 10 Mar., 7.15 p.m.

LIVERPOOL
"Air Brakes for Commercial Road Vehicles," by W. A. Kirk. North Western Centre. Merton Hotel, Merton Road, Bootle, Liverpool 20. Wed., 8 Mar., 7.30 p.m.

Institution of Chemical Engineers

LONDON
"Fluidisation": a symposium. Geological Society, Burlington House, Piccadilly, W1. Tues., 7 Mar., 4 p.m.

MANCHESTER
Annual General Meeting. North Western Branch. Midland Hotel, Manchester. Fri., 10 Mar., 3.30 p.m. (Followed by the annual dinner at 7 p.m.)

Institution of Civil Engineers

LONDON
"Some Experiences with Prestressed Concrete Piles," by S. V. Gardner and D. H. New. Tues., 28 Feb., 5.30 p.m.*
"The Problem of Housing Large-Scale Plant," by W. S. Atkins and Howard Lobb. Joint meeting with the Royal Institute of British Architects. Tues., 7 Mar., 5.30 p.m.*
"Instrumentation for Traffic Engineering Studies, with Particular Reference to Vehicle Detectors, Counters and Speed Meters": Discussion, to be introduced by J. A. Hillier. Traffic Engineering Study Group. Thurs., 9 Mar., 5.30 p.m.*

Institution of Electrical Engineers and Royal Aeronautical Society

LONDON
"Training of 'Electrical' and 'Electronic' Engineers for the Aircraft Industry": discussion, to be opened by G. S. Bosworth. At the Royal Aeronautical Society, 4 Hamilton Place, W1. Wed., 1 Mar., 6 p.m.*

Institution of Electrical Engineers

LONDON
"The Place of Formal Study in the Post-Graduate Training of an Electrical Engineer," by N. N. Hancock and P. L. Taylor. Thurs., 2 Mar., 5.30 p.m.*
"Clinical Value of E.E.G. Recording" and "Present Trends in General-Purpose E.E.G. Recorders": discussions, to be opened by H. B. Morton and H. R. A. Townsend. Medical Electronics Discussion Group. Fri., 3 Mar., 6 p.m.*
"An Investigation of the Usefulness of Back-Scatter Sounding in the Operation of High-Frequency Broadcasting Services," by E. D. R. Shearman. Electronics and Communications Section. Mon., 6 Mar., 5.30 p.m.*
"Automatic Control of Machines for Assembling Mechanical Components," by A. V. Hemingway and R. L. Dressler. Measurement and Control Section. Tues., 7 Mar., 5.30 p.m.*

ABERDEEN
"Generator/Motor Problems in Pumped-Storage Installations," by Dr. J. H. Walker. North Scotland Subcentre. Robert Gordon's Technical College, Aberdeen. Fri., 10 Mar., 7.30 p.m.

BARNSLEY
"Radiocommunication in the Power Industry," by E. H. Cox and R. E. Martin. North Midland Centre. Town Hall, Barnsley. Wed., 8 Mar., 7 p.m.

CARLISLE
"Measured and Electrical Model Characteristics of Buildings Heated by Floor Thermal Storage," by E. D. Taylor, B. Berger and G. Blaylock. North Eastern Centre. Carlisle Technical College, Carlisle. Fri., 3 Mar., 7 p.m.

DUNDEE
"Generator/Motor Problems in Pumped-Storage Installations," by Dr. J. H. Walker. North Scotland Subcentre. Electrical Engineering Department, Queen's College, Dundee. Thurs., 9 Mar., 7 p.m.

EDINBURGH
"An Oscillating Synchronous Linear Machine," by Dr. E. R. Laithwaite and R. S. Mamak. South East Scotland Subcentre. Carlton Hotel, Edinburgh. Tues., 7 Mar., 7 p.m.

Institution of Engineering Designers

LONDON
"Swarf Manufacture," by H. K. Dally. Thurs., 2 Mar., 7 p.m.

Institution of Engineers and Shipbuilders in Scotland

ABERDEEN
"Developments in Marine Steam Turbine Design," by Dr. T. W. F. Brown. Robert Gordon's Technical College, Aberdeen. Fri., 3 Mar., 7.45 p.m.

Institution of Heating and Ventilating Engineers

LONDON
"The Second Edition (1959) of the Institution's Guide": Discussion, to be introduced by members of the Guide Committee. Institution of Mechanical Engineers, 1 Birdcage Walk, St. James's Park, SW1. Thurs., 9 Mar., 6 p.m.*

BRISTOL
Annual General Meeting. South Western Branch. RWA School of Architecture, Bristol. Tues., 7 Mar., 6.30 p.m.

NEWCASTLE UPON TYNE
"High-Velocity Air Conditioning," by C. P. Swain. North East Coast Branch. Neville Hall, Westgate Road, Newcastle upon Tyne. Tues., 7 Mar., 6.30 p.m.

Institution of Highway Engineers

LONDON
"Lessons Learned on the Design, Construction and Maintenance of Motorways from the Ministry of Transport Angle": Discussion. Institution of Structural Engineers, 11 Upper Belgrave Street, SW1. Fri., 3 Mar., 5.30 p.m.

CARLISLE
"Surface Dressing": Symposium. Northern Branch. The Courts, Carlisle. Fri., 3 Mar., 6.30 p.m.

Institution of Mechanical Engineers

LONDON
"Advantages of Increased Pressures and Temperatures and Ratings of Large Steam Power Plant": Discussion, to be opened by J. C. London. Steam Power Plant Group. Tues., 28 Feb., 6 p.m.*
"Mechanism of Combustion Deposit Formation and Adhesion": Symposium. Meeting in conjunction with the Internal Combustion Engine Group. Wed., 8 Mar., 4 p.m.
"Teaching Thermodynamics": Discussion to be opened by Professor D. B. Spalding. Education Group. Fri., 10 Mar., 6 p.m.*

CHESTERFIELD
"Mechanical Handling Equipment and Its Applications," by F. T. Dean. East Midlands Branch. College of Technology, Chesterfield. Thurs., 2 Mar., 7.15 p.m.

EDINBURGH
"Blaenau Ffestiniog and Other Medium-Head Pumped Storage Schemes in Great Britain," by H. Headland. North British Hotel, Edinburgh. Fri., 3 Mar., 6.30 p.m.

GLASGOW
"Blaenau Ffestiniog," by H. Headland. Scottish Branch. Royal College of Science and Technology, Glasgow. Thurs., 2 Mar., 7.30 p.m.

GLOUCESTER
"Jodrell Bank Radio Telescope," by C. N. Kington. Western Branch. Joint meeting with the Gloucester Engineering Society. Technical College, Brunswick Road, Gloucester. Fri., 10 Mar., 7.30 p.m.

NEWCASTLE UPON TYNE
"Blaenau Ffestiniog," by H. Headland. North Eastern Branch. Neville Hall, Westgate Road, Newcastle upon Tyne. Mon., 6 Mar., 6 p.m.

Institution of Production Engineers

BRIGHTON
"Economics of Materials Handling," by A. G. Hayek. Brighton Group. Old Ship Hotel, Castle Square, Brighton. Wed., 1 Mar., 7 p.m.

Institution of the Rubber Industry

BURTON-ON-TRENT
"Scientific Basis of Vulcanisation," by Dr. C. G. Moore. Burton-on-Trent Section. Midland Hotel, Station Street, Burton-on-Trent. Mon., 6 Mar., 7.30 p.m.

Institution of Structural Engineers

LONDON
"Model Methods, with Particular Reference to Three Recent Applications in the Field of Steel, Composite and Concrete Construction," by Professor S. R. Sparkes and Dr. J. C. Chapman. Thurs., 9 Mar., 6 p.m.*

Junior Institution of Engineers

LONDON
"The Grand Contour Canal as a National Water Grid," by J. F. Pownall. Fri., 10 Mar., 7 p.m.*

Newcomen Society

LONDON
"The Early Development of the Trolley Bus," by A. S. Crosley. Wed., 1 Mar., 5.30 p.m.

Reinforced Concrete Association

BIRMINGHAM
"Prestressed Concrete Bridges," by E. W. H. Gifford. Midland Counties Branch. Birmingham and Midland Institute, Paradise Street, Birmingham. Tues., 7 Mar., 6 p.m.*

Royal Aeronautical Society

CHESTER
"Some Low Speed Problems of High-Speed Aircraft," by A. Spence and D. Lean. Grosvenor Museum, Chester. Wed., 8 Mar., 7.30 p.m.

Royal Institution

LONDON
"Energy," by Professor Ronald King. Fri., 10 Mar., 9 p.m.

Royal Society of Arts

LONDON
"The Steel Industry Today and Tomorrow," by Sir Andrew McCance. Wed., 8 Mar., 6 p.m.

Sheffield Metallurgical Association

SHEFFIELD
"Problems of Ferro-Alloy Analysis," by G. M. Holmes. BISRA Laboratories, Hoyle Street, Sheffield. Tues., 7 Mar., 7 p.m.

Society of Instrument Technology

LIVERPOOL
"Design, Application and Selection of Automatic Control Valves," by P. Stone. Liverpool Section. Industrial Development Centre, Manchester and North Wales Electricity Board, Liverpool. Thurs., 9 Mar., 7 p.m.

The address and telephone number of the headquarters of each institution are given below. Meetings in the headquarters town are held there unless otherwise stated. An asterisk (*) is placed where it is understood that refreshments are available prior to the time stated.

British Institution of Radio Engineers, 9 Bedford Square, London, WC1. (MUSeum 1901)
Chemical Society, Burlington House, Piccadilly, London, W1. (REGent 0675)
East Midlands Metallurgical Society. Apply to Mr. E. D. Knights, 10 Penrhyn Avenue, Derby.
Illuminating Engineering Society, 32 Victoria Street, London, SW1. (ABBey 5215)
Institute of Metals, 17 Belgrave Square, London, SW1. (BELgrave 3291)
Institute of Petroleum, 61 New Cavendish Street, London, W1. (LANgham 3583)
Institute of Physics and the Physical Society, 47 Belgrave Square, London, SW1. (BELgravia 6111)
Institute of Refrigeration, New Bridge Street House, New Bridge Street, London, EC4. (CENtral 4694)
Institute of Road Transport Engineers, 69 Victoria Street, London, SW1. (ABBey 6248)
Institution of Chemical Engineers, 16 Belgrave Square, London, SW1. (BELgravia 3647)
Institution of Civil Engineers, Great George Street, London, SW1. (WHItehall 4577)
Institution of Electrical Engineers, Savoy Place, Victoria Embankment, London, WC2. (COVent Garden 1871)
Institution of Engineering Designers, 38 Portland Place, London, W1. (LANgham 8847)
Institution of Engineers and Shipbuilders in Scotland, 39 Elmbank Crescent, Glasgow, C2. (Central 5181)
Institution of Heating and Ventilating Engineers, 49 Cadogan Square, London, SW1. (SLOane 3158)
Institution of Highway Engineers, 47 Victoria Street, London, SW1. (ABBey 3891)
Institution of Mechanical Engineers, 1 Birdcage Walk, St. James's Park, London, SW1. (WHItehall 7476)
Institution of Production Engineers, 10 Chesterfield Street, London, W1. (GROsvenor 5254)
Institution of the Rubber Industry, 4 Kensington Palace Gardens, London, W8. (BAYswater 9101)
Institution of Structural Engineers, 11 Upper Belgrave Street, London, SW1. (SLOane 7128)
Junior Institution of Engineers, Pepys House, 13 Rochester Row, London, SW1. (VICtoria 0786)
Newcomen Society, Science Museum, Exhibition Road, London, SW7. (KENsington 1793)
Reinforced Concrete Association, 94-98 Petty France, London, SW1. (ABBey 4504)
Royal Aeronautical Society, 4 Hamilton Place, London, W1. (GROsvenor 3515)
Royal Institution, 21 Albemarle Street, London, W1. (HYDe Park 0669)
Royal Society of Arts, John Adam Street, Adelphi, London, WC2. (TRAfalgar 2366)
Sheffield Metallurgical Association, 64 Crescent Road, Sheffield 7. (Sheffield 52865)
Society of Instrument Technology, 20 Queen Anne Street, London, W1. (LANgham 4251)

Four Factors Govern Petrol Consumption

Traffic density, particularly in towns, seriously affects fuel consumption, as do the weather, the driver and sparking-plug efficiency. These factors have been experimentally compared in Western Germany.

By E. H. Bush, A.M.I.Mech.E.

FUEL economy is a matter of interest both to the private motorist and to the road haulage industry as a whole. Apart from the general condition of the engine, there are four factors that govern the fuel consumption of a given vehicle: (*a*) traffic conditions; (*b*) ambient temperature and humidity; (*c*) driver temperament and skill; and (*d*) sparking plug efficiency.

Dr. Martin Rossenbeck, of Bochum, Western Germany, has recently published some figures in the *Automobiltechnische Zeitschrift* (ATZ, October 1960) which will provide a factual basis for discussion. Commenting on the rapid increase in traffic density, Dr. Rossenbeck forecasts a doubling of the present number of private cars on the road in West Germany by 1966; the network of classified roads, however, has only increased by 4 per cent over the last 10 years—figures that must startle and dismay German motorists.

The position in Great Britain is actually considerably worse. In the five years from 1953 to 1958, our network of classified roads increased by just under 0·4 per cent. In the same period the total number of private cars registered increased by 66 per cent, and the total number of registered vehicles on the road by 51 per cent (*Annual Abstract of Statistics*, No. 96, 1959). In view of the consequent general slowing down of traffic, the question of fuel consumption becomes increasingly significant.

The investigations undertaken concerned the fuel consumption of four different sizes of cars, graded according to engine capacity, and incorporating 4 speed gearbox with mechanical transmission. The vehicles selected were of 1·2 litre, 1·5 litre, 1·9 litre and 2·2 litre capacity respectively, and represent 35 per cent by make and 63 per cent by size of all passenger cars registered in West Germany.

As a basic standard of comparison, the manufacturer's own figures for fuel consumption were used in each case. These figures are derived from a procedure laid down by the German Industrial Standards Specification (DIN), according to which a level track 10 kilometres long must be covered both ways at 75 per cent top speed (but not exceeding 69 mph) in windstill weather conditions. A further 10 per cent must then be added to the amount of fuel used. This procedure obviously takes no account of traffic conditions or the influence of gearchanging, since the car remains in top gear over the tested distance.

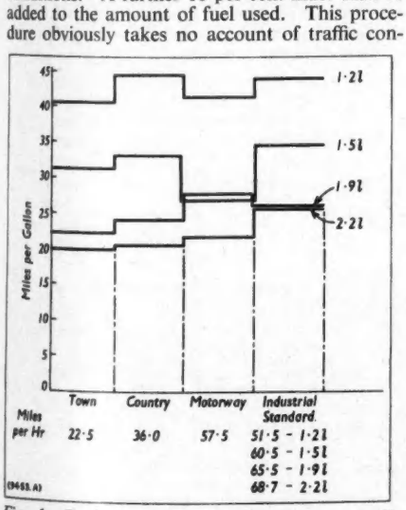


Fig. 1 Fuel consumption under various traffic conditions.

In test reports published in various automobile technical journals, reference is often made to road fuel consumption (that is subject to normal traffic conditions), but the results are usually derived statistically and over an arbitrarily selected route. The fuel consumptions to be discussed here, on the other hand, were obtained on a definite circular route which was traversed many times.

The route selected covered a large part of the Ruhr, and consisted of 179 miles divided equally into town, country and motorway (*Autobahn*). Town traffic, in this connotation, does not imply bumber to bumper traffic, but normal " through " traffic impeded solely by crossroads, traffic lights and miscellaneous traffic obstacles.

In view of the difference in engine size and for reasons of safety, the following maximum speeds were laid down: town—31 mph, country —50 mph, and motorway—75 mph.

TRAFFIC DENSITY

Traffic density is often defined as the number of inhabitants in the area per vehicle on the road. More appropriately it can be defined as the number of vehicles for a given length of road, or better still, per acre of road surface. According to a survey made in 1959, the traffic density over the test route, with reference to the above definitions, was as follows: 14 inhabitants per vehicle, 59 vehicles per mile, and 32 vehicles per acre. From these figures it is evident that the test route covered an area of heavy traffic density, and can therefore be taken as representative of traffic conditions in general.

In order to put the tests on a broad basis, four different makes of vehicle, all of which are in standard production in Germany, were tested, one vehicle only being used for each capacity group. Of the four cars selected, three had four cylinders and one six cylinders. The compression ratios were as follows.

1·2 litre—7·6 : 1
1·5 litre—8·0 : 1
1·9 litre—7·5 : 1
2·2 litre—8·7 : 1

The compression ratios therefore warranted the use of " super " grade petrol in all cases.

Fig. 1 shows the fuel consumption of the four cars along the three sections of the route, grouped according to engine capacity, for town, country and motorway driving, and also for the average speed maintained, which was between 72 and 76 per cent of maximum permissible speed along each section. For comparison, the fuel consumptions obtained by the Industrial Standard procedure are shown in the extreme right-hand column, together with the corresponding speeds. The diagram demonstrates that the fuel consumption based on this procedure can only be regarded as the lowest that could be attained under ideal conditions, and that normal traffic conditions yield a higher consumption at lower speeds. " Town driving," as may be expected, gave the highest consumption for all but one vehicle.

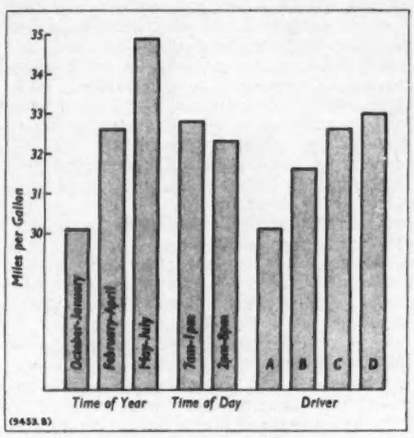


Fig. 2 Variation of fuel consumption with time of year, time of day and different drivers.

Influence of time of year, time of day, and variation for different drivers is shown in Fig. 2. The 1·5 litre car was selected for these tests, and the stated fuel consumptions refer to average consumptions over the whole route. The measurements were made between the end of 1958 and the middle of 1959, and show the favourable influence of the warm and dry summer weather on fuel consumption.

Variations of consumption with time of day

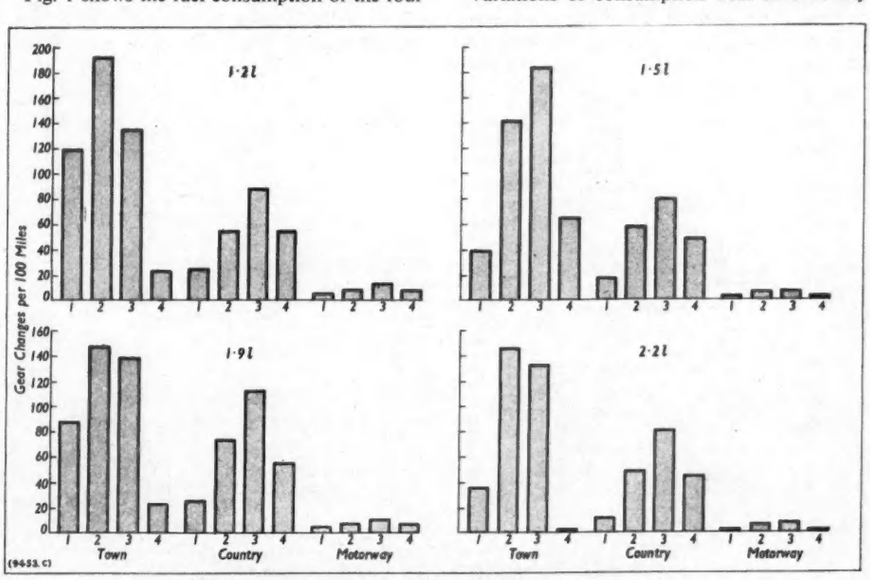


Fig. 3 Gear change frequency distribution per 100 miles.

are hardly noticeable, since the selected times (between 7 a.m. and 1 p.m., and between 2 p.m. and 8 p.m.) invariably covered peak traffic conditions with people travelling to and from work.

The influence of driving habit, on the other hand, is very marked, the worst case exceeding the best by some 10 per cent in fuel consumed.

In order to analyse driving conditions along various parts of the route, the number of gear changes, the time in each gear and the time range for various engine rpm's were recorded. The equipment used for this purpose consisted of a tachodynamo, which, driven by the car dynamo, generates an alternating current proportional to engine speed. This current is led to a serial switch consisting of 10 Kathode-thyratrons, which in turn control, through relays, 10 different counters. A selector switch ensures that only the counter appropriate to the speed range being recorded is in action.

Altogether 4 series of 10 counters were used, each series representing one gear, and connected accordingly to the gearshift by means of switches, thus recording ten rpm ranges in each gear. A contact stopwatch with 0·5 second pulses was used to time the measurements.

Fig. 3 shows the number of gear changes for each gear over a driving distance of 100 miles for the four vehicles, grouped according to town, country and motorway conditions. Noteworthy is the much more frequent use of second gear in town as compared with country driving. Fig. 4 shows the use of the various gears in percentage of driving time, and indicates that third gear is the most commonly used in towns.

The frequency distribution of rpm ranges for the different route sections for each vehicle is shown in Fig. 5. Driving time was chosen as ordinate, and the percentage of the appropriate maximum rpm as abscissa. As could be expected from an examination of Fig. 4, the most frequently occurring rpm ranges lie closely together for town and country driving, and do not often exceed 60 per cent of the maximum rpm.

The detailed information thus obtained about the behaviour of the engine on the road provides valuable data applicable to the initiation of tests on engine testbeds. Weather conditions are frequently unsuitable for the exacting requirements of road tests, and in any case the accuracy of measurements thus obtained may not be sufficient when exact repeatability is required. However, both accuracy and repeatability are possible by means of " programming " an engine on the testbed, and the data previously obtained on the road can now be used to work out an appropriate " programme ".

For special investigations, say about the mixture distribution to the individual cylinders, residue in the combustion space, octane number requirements or knocking, the importance of identical conditions from one run to the next is obvious. The excellent repeatability by means of programmed runs has been demonstrated,

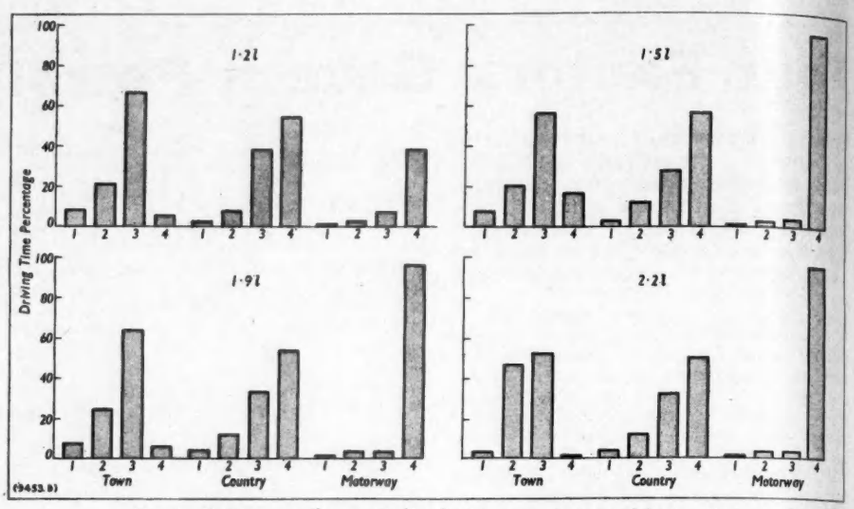


Fig. 4 Driving gear frequency distribution as percentage of driving time.

after inspection of pistons of two engines run consecutively for 200 hours under town driving conditions (representing 4,690 miles).

The lesser weight of deposits on the outer pistons indicated, in this particular case, that the fuel-to-air mixture reaching these cylinders was not as good as for the others. This discovery also agreed well with the results of measurements of knocking tendencies of individual cylinders.

DEPOSITS

Additional residues in the cylinder head were also examined, in view of the importance of the condition of valves and spark plugs, which have a marked influence on engine performance.

After 200 hours town running the sparking plugs were found bedded in deposits showing a definitely recognisable structure. Chemical analysis of the residues showed that these consisted not only of the fuel combustion residues, but also all the residues of combustion of the engine oil, indicating that both fuel and oil residues must be examined together for a complete evaluation. The functional influence of the two kinds of residue, though very similar in appearance, can be quite different, as demonstrated by different knocking tendencies.

This result will also be demonstrated by an example about the functioning of the sparking plugs, which lend themselves particularly well to the observation of details of deposit formation, partly because the very high local temperatures favour certain reactions, and partly because it is easy to control the functional behaviour of the sparking plugs during and after running. Analysis of these deposits shows that they contain all the products of combustion of the fuel and oil, including additives.

Conditions favourable to " bridging " at the electrodes arise when a high lead-content fuel is used together with a highly blended oil under certain weather conditions, for example, high relative humidity. Engines burning a considerable amount of oil, such as two-stroke engines, are particularly prone to this condition.

There are other types of " bridging," in which the electrode is not immediately shorted out, but where the increasing deposits cause a corresponding " burning-off " of the electrode. After initial misfiring the plug eventually fails completely. This failure can occur under town driving conditions, using leaded fuel, in as little as 144 hours.

An example of the different effects of deposits of similar appearance is provided by the magnitude and variation with temperature of the insulation resistance, which is a measure of the efficiency of the plug, as demonstrated in Fig. 6. The insulation resistance was measured with the plugs heated to the required temperatures in an electric oven, using one new plug and three plugs subjected to 200 hours town driving, firing on fuel without additives and highly blended oil in one case, and high additive fuel with moderately blended oil in the remaining two cases.

In spite of the similarity of appearance of the used plugs, considerable differences in the insulation resistance proved the importance of the chemical composition of the deposits.

It is to be regretted that Dr. Rossenbeck made no attempt, in his report, to analyse the driver influence on petrol consumption, a subject that would have been of great interest to all motorists. But his methods in applying actual test data to the programming of engines on the testbed may well lead to further improvements in engine efficiency, and more mpg for the motorist where he needs it most—in town.

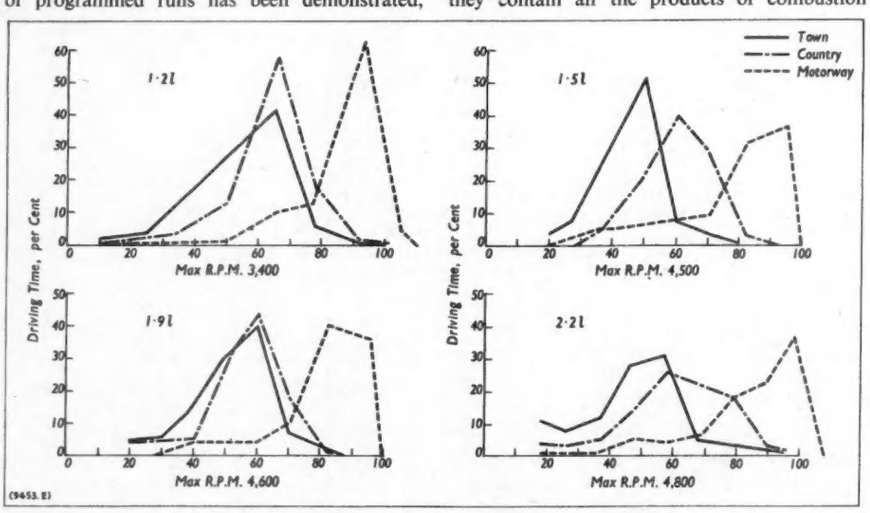


Fig. 5 Distribution of rpm as percentage of driving time.

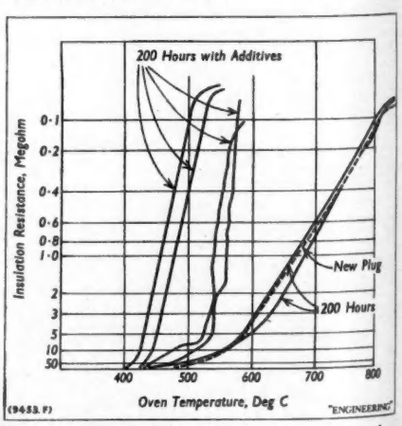


Fig. 6 Variation in insulation resistance for plugs used with different fuels and engine oils.

Human Element

How to Avoid Fires in the Works

A VALUABLE series of proposals for control by builders and structural engineers to reduce fires caused by work being done in alterations, repairs, decorations and new construction is put forward in the current *Fire Protection Bulletin*, the quarterly journal issued by the Fire Protection Association.

Among examples of the costly fires sparked off by repair work is the £1 million cotton mill blaze which followed the use of a blowlamp to repair a cold water pipe. The blowlamp set alight a piece of fluff which fell on to a bale of cotton and the full scale fire then followed.

In another cotton mill sparks falling from an oxy-acetylene torch in use on another pipe set a heap of sawdust smouldering and a serious outbreak followed, causing damage that amounted to £110,000.

Blowlamps, oxy-acetylene equipment, bitumen, temporary heating and low flash-point flammable liquids used in the sort of adhesives used in tile laying, paint thinners and solvents, are listed by the Fire Protection Association as being among the chief fire hazards encountered in building operations. An important contributing factor to the level of losses in fires in new buildings has been the tendency to accumulate valuable equipment in one place, with no access allowed should it become necessary for firemen to get in.

At this stage in the work automatic fire alarms are often unconnected, water supplies have not yet been laid on to automatic sprinklers and if fire does break out there may be a dangerous time lag in raising the alarm since the telephones may not have been installed.

The salutory example is quoted of the newspaper for which a new office was being constructed who lost almost £500,000 in two fires before the building was ready for occupation.

How are all these risks to be minimised? The FPA suggests that those in charge of work should not permit certain possible fire-causing operations to be undertaken until they have satisfied themselves first of all of a number of conditions that are, in the main, common sense but which taken together amount to a useful fire-avoiding routine.

Blowlamps should only be permitted, the Association recommends, where there is no other way of carrying out the work. The operator's attention should be drawn to any special hazards, such as concealed cavities behind the surface on which the blowlamp will be used. The requirement that there shall be a fire extinguisher handy is certainly one that not every firm carries out at the moment. The conditions to be satisfied before the work is allowed to begin also include making sure that there are no flammable liquids about, such as petroleum or acetone, and seeing to it that the work is not left until it is certain that nothing is smouldering.

Cutting and Welding

Before the man in charge allows cutting and welding to begin the Association suggests he should be sure that: the work cannot be carried out satisfactorily in a welding shop; that sparks and hot electrode stubs cannot fall on to combustible materials and that metal receptacles are provided for electrode stubs. As with the blowlamp it is important to be certain that there is nothing behind the work which may be set on fire by the flame or by conducted heat and that there is no inflammable material in contact with the flame.

Again, as with the blowlamp, precautions should be taken to see there are no such liquids as petroleum or acetone about and that there is a fire extinguisher to hand.

Bitumen Handling

Various fires have taken place where bitumen has been in use and the chief safety proposal put forward is that bitumen should only be heated in an area where if it overflows it can be controlled, and where should it ignite, the fire can be extinguished without spreading to other premises. The process should be continually supervised and there ought also to be "at least one two-gallon foam extinguisher" within easy reach.

On fire extinguishing equipment the bulletin points out that workmen should be trained in the use of suitable extinguishers. There should be clear instructions as to what to do if there is a fire. Extinguishers should be protected against frost where they have to be sited outside the building.

Copies of the *Fire Protection Bulletin* are available from the Fire Protection Association, 31/45 Gresham Street, London, EC2 (1*s* 6*d* to non-members).

. . . but if a Fire Breaks Out

A new Ministry of Labour booklet which is also worth obtaining for any factory office is *Fire Fighting in Factories* (HM Stationery Office 2*s*).

The section dealing with recommended standards of fire fighting equipment places emphasis on the provision of mainly portable appliances for "first-aid" action by employees. For premises with normal fire risks the proposed minimum standards are shown in the table.

Fire Fighting in Factories lays considerable emphasis on the importance of correct installation of equipment and its proper maintenance. The efficiency of certain types of extinguisher deteriorates with time and these periods for discharging and refilling the various types are recommended. Every TWO years:—soda acid-turnover type, chemical foam; every FOUR years:—soda acid-sealed acid bottle, water-gas pressure type, mechanical foam. The cases of all water and foam extinguishers should be tested hydraulically every four years.

Floor area of each storey	Minimum standards of equipment
Up to 200 sq. yd . .	One 2 gallon bucket of water for every 40 sq. yd or part of that area, alternatively one or more portable extinguishers of the water type.
200 sq. yd to 1,000 sq. yd	A portable extinguisher or extinguishers of the water type (soda acid or gas pressure) with a capacity of 2 gallons for every 200 sq. yd (or part).
Over 1,000 sq. yd . .	One hose permanently connected to the water supply to cover every 1,000 sq. yd. Alternatively, where the area does not appreciably exceed 1,000 sq. yd, portable extinguishers of the water type having a capacity of 2 gallons for every 200 sq. yd (or part).

Industry Improves the Future for Anglesey

The Government's efforts to reduce the amount of unemployment in the worst affected districts—they include Merseyside, Holyhead and Coatbridge, Scotland—have got under way with the opening of a new factory overlooking Holyhead Bay, Anglesey.

The factory has been taken by the Midland Electric Manufacturing Company, a Birmingham concern who will make switchgear and other electrical equipment there and send it by rail to Birmingham for distribution. It is intended that the factory shall eventually provide jobs for 300 people. So far only one operative and an assistant manager have had to be moved from Birmingham to Holyhead, all the other recruitment has been of local people, who have been trained at the works.

The 26,000 sq. ft factory costs Midland Electric about £2,700 a year in rent and they have an option to buy in the first five years. The company first approached the Board of Trade when they were meeting difficulty in recruiting new labour for expansion in Birmingham.

True to its commitment to encourage the spread of industry to areas of high unemployment, the Board "guided" the firm to look elsewhere than fully-employed Birmingham.

Within a very short time of being given the facts about the Holyhead factory Midland Electric had taken its tenancy. They hope to see a future for the Holyhead unit of steady progress, unaffected as far as possible by any ups and downs that may vary the fortunes of Midlands industry.

For those islanders of Anglesey who are not among the 150 to be taken on by the new works in its first year, or the others who join to bring the numbers up to 300, Mr. Niall Macpherson, Parliamentary Secretary to the Board of Trade, who performed the opening ceremony, held out the hope of a better future with his announcement that new industrial development expected on the island in the next few years would bring almost 1,500 fresh jobs.

An Aircraft Engineer for Shipbuilding Research

The British Shipbuilding Research Association have appointed Mr. Peter G. Hodgkinson, who until recently was chief production engineer at the de Havilland Aircraft Company, to take charge of their production and operational research section.

Mr. Hodgkinson was educated at Birmingham Central Technical College and the Birmingham Commercial College, training as an engineer with W. and T. Avery Limited. He went into the aircraft industry in 1936 as a senior design draughtsman for Boulton Paul Aircraft and, in 1944, moved to the de Havilland Aircraft Company.

His appointments with de Havilland included being in charge of structural test house, chief inspector and, finally, chief production engineer. In this last appointment at Hatfield, Mr. Hodgkinson was responsible for all engineering methods, tool design and manufacture, production research and the budgetary control of this work.

A New Secretary for the Mechanicals

Mr. Kenneth H. Platt, deputy secretary of the Institution of Mechanical Engineers, is to become the secretary of the Institution in succession to Mr. Brian G. Robbins.

Mr. Platt, who was at Shrewsbury and at the University of Glasgow, where he gained a First in Mechanical Engineering, has lectured in the same subject, He has been associated with engineering education and training in industry and was an Inspector with the Ministry of Education. Joining the I.Mech.E. staff in 1952 he became assistant secretary in 1953 and deputy secretary in 1956.

The change takes place on 1 June this year. Mr. Robbins, who has decided to retire before the normal retiring age, has been secretary since January, 1951.

Keen Overseas Interest in Postal Engineering Tuition

From Second World War service for the Ministry of Power in conserving fuel supplies and the discovery of just how few people really knew the best ways to use steam and heat to the full advantage, the Spirax-Sarco engineering group has expanded its educational activities until the enrolment of the 50,000th postal student has now been celebrated.

The 50,000th student to joint the Spirax Postal Instruction Courses was in fact William Greenwood, an 18 year old apprentice with Brightside Heating and Engineering, the heating contractors, working at Newcastle upon Tyne. But he could have been from much further afield since the courses have been taken by future engineers in 64 countries. About a fifth of all the students have been living overseas. There is even the small, highly keen, band of students who are improving their engineering knowledge while serving prison sentences.

Sixteen years ago, after its war experience, the company devised and offered without charge, three postal courses. They were on steam for process and heating, at elementary and advanced levels and what is called the "ABC of Temperature Control."

As the Spirax-Sarco export business grew the even greater demand for the courses overseas began making itself felt. Many of the most hard working students are found in areas where technical instruction is not equal, at every stage, to the standards taken for granted in industrial nations of longer standing. The company has found such cases to be India, Australia, New Zealand, and South-East Asia.

Power and Park Developments at Niagara

The Power Authority of the State of New York is building a 2,190 MW project to utilise their share of the water from the Niagara River. Simultaneously works are in hand to improve the amenities of the area as a tourist attraction.

THE POWER AUTHORITY of the State of New York is building the Niagara power project under a State directive to produce electrical energy urgently needed in the area. A chronic power shortage has existed since June, 1956, when a major part of the Schoellkopf power station near to the Falls was destroyed by a rock fall.

A licence to develop Niagara power on the United States side was issued as recently as January, 1958. The first power goes on line today, 10 February, 1961, only three years after the award of the first construction contract. The project is to cost $720,000,000 and will be completed in 1963.

The firm power, based on the most adverse combination of peak daily power demand and low river flow, will be 1,800 MW. A 250 mile transmission line, partly at 345 kV, will link the new station with the Robert Moses power dam at St. Lawrence, enabling the output at both stations to be increased. Swapping power between the two stations is feasible, and economic, because high flow on the St. Lawrence coincides with maximum restriction on abstraction at Niagara, and vice versa.

The Niagara River forms the boundary between the State of New York and the Province of Ontario between Lakes Erie and Ontario. Though only 34 miles long, the river drains four of the five great lakes—a water area of 265,000 square miles. The average flow is 202,500 cu. ft per second and the maximum flow is only slightly more than twice the minimum, a trivial fluctuation compared with that of most of the world's great rivers. The Niagara is thus one of the world's most dependable sources of water power.

The river drops 160 ft at the Falls but there is a drop of 50 ft through the cataracts above the Falls and another of 115 ft through the several rapids downstream of the Falls. Intakes are therefore located near to the level of Lake Erie and the tailrace near to that of Lake Ontario. The Niagara plant, like its sister stations on the Canadian side—the Sir Adam Beck stations 1 and 2—takes advantage of 314 ft out of the possible 326 ft existing between the two lakes.

1950 TREATY

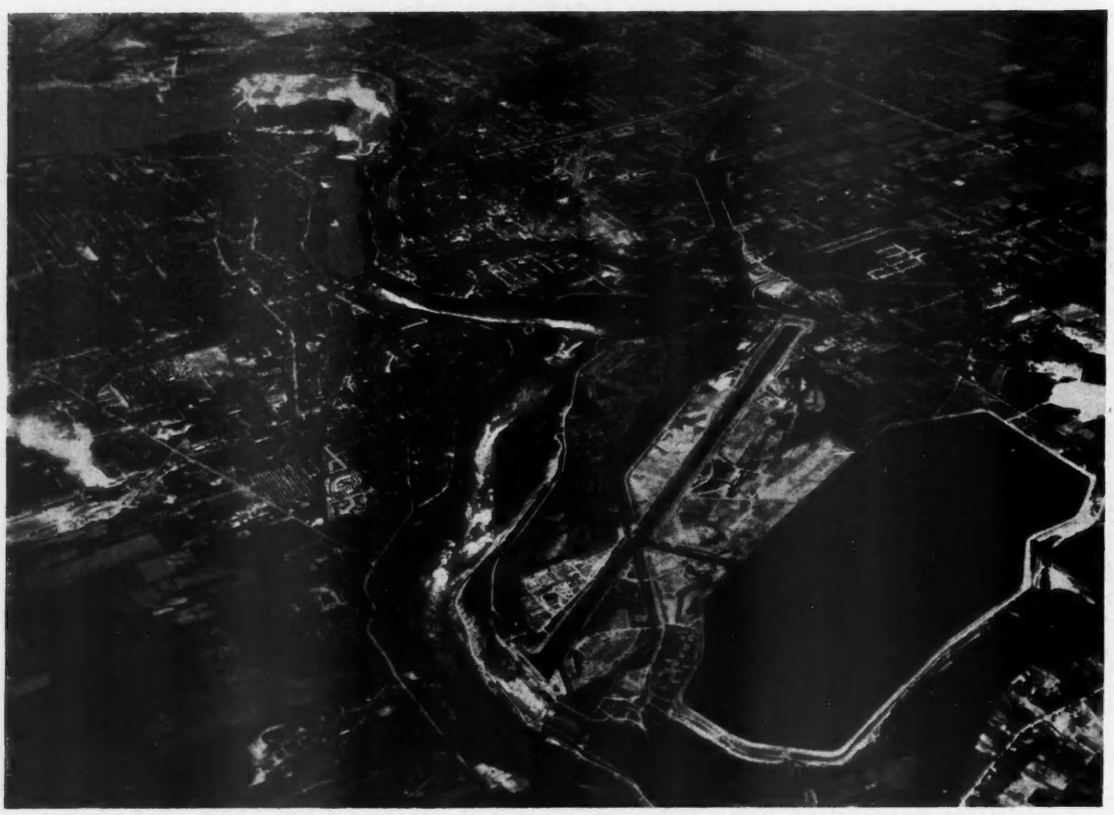
In addition to the power potential, the Falls are one of the world's great scenic attractions. On the Canadian side the dual development of power project and national park, with the full preservation of the beauty of the area, has long been under the control of the Hydro-Electric Power Commission of Ontario, but on the United States side there has not been the same overall authority, able to control the growth of commercial enterprises along the river frontage. Restriction on the amount of water that could be taken from the river has existed since 1906. The present situation is governed by the treaty of 1950 which lays down that in the daylight hours during the tourist season at least 100,000 cusecs must flow over the Falls. At other times, including night time in the tourist season, the flow may be reduced to 50,000 cusecs. The diverted water is shared equally between the two nations—though it is to be noted that until the Niagara project comes into full operation, the United States are unable to take their full quota and the Canadians are able to enjoy the surplus thus made available to them and are able to export current.

It is the increased amount of water that can be drawn off during the hours of darkness throughout the year that has made desirable the reservoirs that have been built on both sides of the river for pumped storage schemes.

A prime requirement of the 1950 treaty was the preservation and enhancing of the natural scenic beauty of the Falls. To this end a number of remedial works are being constructed under the direction of the International Joint Commission by Ontario Hydro and the US Army Corps of Engineers.

These remedial works consist of the Chippawa-Grass pool control structure which regulates both the flow of water over the Falls and the water level in the pool where the intakes for the Canadian stations have been working for some years and where the Power Authority's new intake has recently been completed. The control structure will ensure a uniform and sufficient curtain of water over the Falls, allowing water to be withdrawn for power purposes without spoiling the beauty of the Falls; moreover, the reduced flow over the Falls will reduce erosion and thereby prolong their life as a scenic attraction.

In conjunction with the power scheme the Authority are also building the Niagara Parkway along the shore of the river. It is being built on rock fill obtained from excavations on the power scheme and will run all the way from the Grand Island bridge to the head of the upper rapids above the Falls. From Rainbow bridge it will run along the gorge and eventually it will be extended to the mouth of the river and then along the lake shore to join with existing Lake Ontario Parkway. A new American Rapids Bridge crossing to Goat Island has been constructed (ENGNG., vol. 190, p. 748, 2 Dec. '60). The Niagara Expressway has been built as part of the Federal-State arterial road system. And, in addition, a 100 acre park is to be built by the Authority adjacent to the reservoir near the Tuscarora power station.



Aerial photograph of the site of the Niagara power projects taken about three years ago. The American scheme now occupies the left (east) bank of the river, and the Canadian scheme, then already completed, is on the right. The Sir Adam Beck pumped storage reservoir is in the right foreground, with its pumping generating station on the left bank. (This station is mentioned elsewhere in this issue in connection with the Deriaz turbine.)

The Niagara River drains four of the five great lakes, a water area of 265,000 square miles.

The Niagara power project comprises the intakes, 2½ miles above the Falls, a conduit and canal system leading to the forebays, the main Lewiston power station, with its installed capacity of 1,950 MW, and the Tuscarora pumped storage plant of 240 MW, with its associated reservoir of 60,000 acre-ft capacity.

MAIN PLANT

The main intake, above the Falls, consists of two structures, each 700 ft long, one for each of the two main conduits, and are of the harmonica type, so named because of their appearance. Each structure contains 48 openings, the tops of which will vary from 13 to 26 ft below the surface of the river. Both conduits are fitted with vertical lift gates 49 ft wide and 68 ft high, but as a cautionary measure slots have been installed to take stop logs. To draw adequate water from the river at the intake, the bottom of the river has been dredged to the shape of a half funnel covering nearly half a square mile; in addition a 2,000 ft long rock-fill dyke will direct the flow towards the intake.

The twin conduits run in a northerly direction from the intakes to the south-west corner of the reservoir, a distance of about 4½ miles. Each conduit is 46 ft wide and 66 ft high to the crown of the arch roof. Their combined capacity is 83,000 cu. ft of water per second at a water speed of 14 ft per second. The average cover over the conduits is 40 ft but they were constructed by cut-and-cover methods. Their average fall is ¾ in every 100 ft.

The L-shaped open canal between the conduit outlets and generating plant forebay comprises a transition section about 1,800 ft long (which includes the Tuscarora plant forebay/afterbay) and a channel 500 ft wide, nearly 3,000 ft long and 110 ft deep between the forebays of the two plants. This channel is open and will act as a surge basin to absorb energy in the moving water should an emergency require the generating plants to be closed down quickly.

The storage reservoir will take up the extra water diverted from the river at night. It is being formed by the construction around the perimeter of a rock-fill dyke with an impervious core. The average height will be 55 ft, and the base width 240 ft; the crest will be 41 ft and will include a 20 ft roadway. Storage will thus be above natural ground level and considerable grouting under the dyke will be required to prevent seepage.

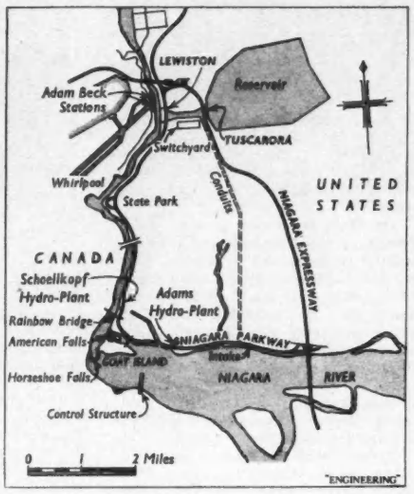
The installed plant at Niagara will be amongst the world's largest—there are thirteen 150 MW turbo-generator sets. A semi-outdoor arrangement has been adopted. It consists basically of an intake in the forebay at ground level and the generating plant at river level, the two connected by penstocks. The intake, about 1,100 ft long, is of the gravity type comprising 13 blocks each with trash racks, stop log slots and vertical lift gates. Welded steel encased in concrete has been used for the penstocks, which are 462 ft long and of 21 ft diameter at the scroll case.

The generating equipment is thirteen blocks, each with a Francis type turbine rated at 200,000 hp at 300 ft head (the normal operating head will be 350 ft) and a 150 MW generator operating at 120 rpm, 3 phase, 60 cycles. The turbo-generators are mounted below the deck under removable hatch covers. Power is generated at 13,800 volts and stepped up to 115,000 and 230,000 volts to meet transmission requirements. In addition transformers in the switchyard can step up the voltage to 345 kV.

PUMPED STORAGE

The Tuscarora pump-generating plant is sited a mile from the gorge behind the main station. At night, surplus power from the main plant will be used by the Tuscarora units to pump extra water available under the 1950 Treaty into the reservoir. At times of peak demand, the stored water is to be released to flow through the plant which is reversed to act as turbo-generator sets. Besides generating 240 MW at Tuscarora, the water passes into the power canal and thence through the main plant.

The reversible pump-generating units consist of twelve motor-generators connected to twelve



The project area: the plant exploits a head of 314 ft out of a possible drop of 326 ft between Lakes Erie and Ontario.

hydraulic pump-turbines. Each electrical unit is rated at 37,500 hp as a motor and at 20 MW as a generator, operating at 112·5 rpm in both directions. Each hydraulic unit is able to raise 3,400 cusecs against a head of 85 ft as a pump and to develop 28,000 hp at 75 ft head as a turbine.

The Niagara switchyard is located on a 35 acre site south of the power canal and has three voltage sections: 115 kV, 230 kV, and 345 kV. Current enters the yard by seven 115 kV and six 230 kV circuits from the main plant and by four 230 kV circuits from the Tuscarora plant. In the 345 kV section there will be 15 disconnecting switches and four oil circuit breakers rated at 25 million KVA capacity. The 345 kV line will be the highest voltage transmission line in the Eastern United States and will form part of the State Power Authority's tie line with their generating station on the St. Lawrence.

Permission to go ahead with the Niagara power scheme was given by the Federal Power Commission in January, 1958. After only three years the first current is coming on line and the whole scheme is scheduled for completion within four years of commencing construction. The engineering consultants to the Power Authority are Uhl, Hall and Rich.

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500 ft High Building for London

To meet Post Office requirements for expansion of communication circuits over the next 40 years, a 500 ft high tower is to be built in the centre of London at the Museum telephone exchange. The tower will have a diameter of 54 ft and the stability of the upper reaches of the structure will be provided by a reinforced concrete shaft of 20 ft diameter, which will also serve to house the high speed lifts, cables and other services.

At the head of the shaft there will be a steel yoke and the floors will be supported by a lantern framework hanging from the yoke. The function of the building is reported elsewhere in this issue.

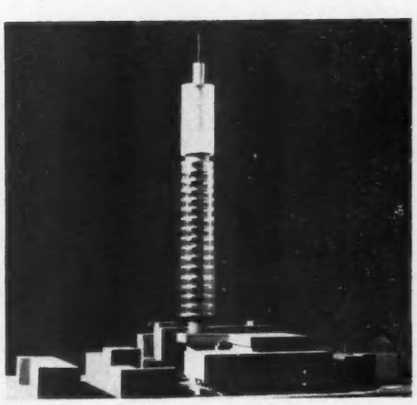
The upper section of the structure had to be circular because it will have to be possible to transmit signals through 360° and it will be clad in an opaque plastic that will cause minimum interference with the signals. Below the aerial galleries, the same circular form will be adopted, glazed throughout in non-corrosive metal sections; the external skin will be continued for the full height and "obscuration" to sill height will be provided internally. Windows will be double glazed. Apparatus floors will be fully air conditioned, using concealed ducting.

Slender towers are sensitive to variations in temperature and to wind loading; differential settlement is also critical. To meet the conditions imposed by the transmission requirements, the lateral deflection is limited to 20 in. It is estimated that wind gusts of 70 mph will induce a deflection of 6 in and that under a summer mid-day sun movements of 2 in can be expected. The conditions under which sympathetic oscillations might occur are being explored by wind tunnel tests on a scale model of the tower at the National Physical Laboratory, Teddington, to ensure that this possibility cannot occur.

The subsoil consists of a water-bearing gravel overlying blue clay at a depth of 25 ft. The foundation will be formed in the blue clay and will comprise a square truncated pyramid of reinforced concrete construction, 90 ft wide by 22 ft deep, with prestressed and reinforced concrete bearing panels. The all-up weight of the tower and the foundation will be 13,000 tons.

Below the height of 115 ft above ground level, the diameter of the concrete shaft will be increased to 28 ft at the top of the section and to 35 ft at the base.

Stability of the tower will be increased by a bridge deck leading to the adjacent main building at a height of 80 ft above ground. This deck

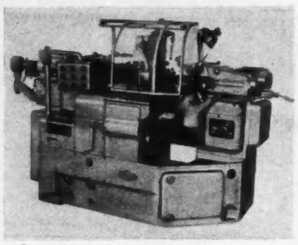


will transmit a thrust load of 500 tons and the structure of the main building is to be stiffened to resist this restraint.

The design has been made by the Ministry of Works for the General Post Office and has received the approval of the Royal Fine Art Commission. Construction is expected to start later this year and the tower to come into operation in mid-1964.

AUTOMATIC TURRET LATHE

Button Control



VARIOUS attachments of ingenious design are claimed to increase the productivity of the new A40A automatic turret lathe by as much as 75 per cent compared with conventional machines.

The main feature of the new design consists in the arrangement of the cams for the feeds to the tool slides. They are centralised in one block, which can be easily replaced as a unit and stored for future use. The levers transmitting the movements from the disc cams to the slides are arranged for an adjustable transmission ratio that allows the same cams to be used for the production of different parts. It is fitted with push-button control, the auxiliary functions being engaged electro-mechanically. Carbide tipped tools are used.

On the turret slide is a plate type turret head which is provided with slots for setting tool holders. The drive for turning and feeding the turret slide is derived from the backshaft through a clutch operated by an electromagnet. The latter is controlled from the control drum with dogs, located on the left side of the machine. The same drum controls speed of engagement, stock feeding, acceleration and deceleration of feed, rapid traverse, and also the turret slide indexing.

The headstock is directly driven from the motor by V-belts. There are four electromagnetic clutches in the headstock, enabling the engagement of four speed rates in one working cycle, two of them for turning and two for threading. The field of application of the machine is increased by use of a special three-jaw chuck.—*Strojexport, Prague, Czechoslovakia.*

FLAME FAILURE RELAY

Rectification Principle

THE improved Protectoglo combustion safeguard relay is suitable for monitoring start up, running, and cut-off for gas or oil-fired ovens.

The unit uses the flame rectification principle and is designed for use with a variety of sensors—flame electrode, photocell unit, infra-red, or ultra violet. Two different kinds of sensor can feed into the unit at the same time.

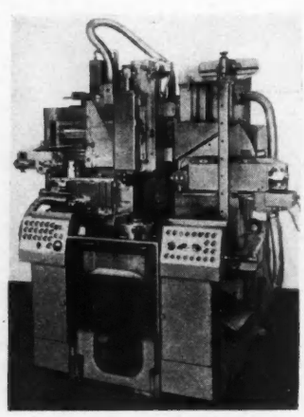
When a flame is present at the sensor, rectified current is fed into one grid of a double-triode valve. In this condition the output current energises a control relay. On flame failure the absence of rectified current causes the valve output current to fall to zero and the control relays will "drop out."

The self-checking safe-start circuit in the relay includes a safety switch and a manual reset button. If a fault is detected during start-up and the safety switch goes into the safety position, the system cannot be started until the unsafe condition is corrected and the manual reset button actuated.

When it is necessary to prevent any attempt to start a burner until expiration of a measured time interval—during which the combustion space may be thoroughly purged of any accumulation of unburned fuel—a purge timer is supplied. This is fully adjustable from 2 to 15 min, or alternatively, from 4 to 30 min. An external signal light indicates when the burner can be started. *Honeywell Controls Limited, Greenford, Middlesex.*

COPYING LATHE

Programme Control



THE SPK 63 semi-automatic vertical lathe is intended for the machining of heavy and bulky components of flange shape.

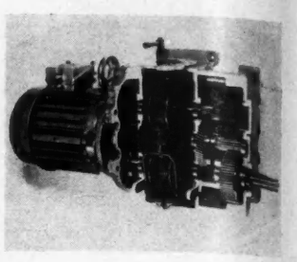
Workpieces up to 630 mm (24½ in) in diameter and 250 mm (9¾ in) in length can be handled by the machine. Two copying carriages and one recessing carriage permit external and internal profiles, shaped faces, perpendicular and angular recesses, and the performance of chamfering and similar operations.

The automatic work cycle is controlled electro-hydraulically and includes the change in sequence of the rapid and cutting feeds to the tool carriages and the change of the spindle speeds and feed rates. The programme is set up according to a record provided on a punched card by the adjustment of stops on drums. Large stock removal, and so high machine efficiency, is made possible by simultaneous machining by means of the three separate carriages, the working movements of which are included in one automatic cycle. In this way as many as 36 operations can be carried out on a workpiece at one setting.

The spindle drive consists of two pole-changing electric motors, one differential planetary gearing, a hydraulically operated duplex friction clutch, and hardened and ground gears. *Strojexport, Prague, Czechoslovakia.*

VARIABLE SPEED UNIT

Smooth Operation



THE "Z" variable speed units enable speed and torque to be varied continuously without slip.

Various sizes of these units are made, with speed ratios varying between 1 : 3 and 1 : 6 and for horse powers up to 30. The normal minimum and maximum speeds are 200 rpm and 2,100 rpm, the maximum torque permissible at the output shaft being 10,000 kg-m (71,000 lb-ft). Efficiencies are about 90 per cent, and units have run up to 3,000 hours without replacement of individual parts in very difficult conditions: for example, in dust, or acid fumes, or at high temperatures.

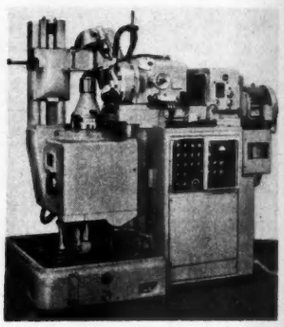
In a totally enclosed cast iron box two parallel shafts rotate in anti-friction bearings, each of them carrying one pair of conical discs provided with feathers. The discs are movable and mounted on the shafts. These are axially pivoted by two double-armed levers actuated by a control screw or pin. A laminated link chain connecting both disc pairs rides between the toothed working faces of the disc. Tighteners on both sides of the chain ensure the correct accommodation of the links and engagement of the laminations.

The speed ratio is changed by moving one of the discs in relation to the other by means of a lever mechanism, so that the chain rises in one pair of discs and falls in the other. The change is only carried out while running, and can be effected mechanically, electrically, or pneumatically.

Input speeds must not exceed 1,000 rpm. When high speed drives must be accommodated a reduction gear on the drive side must be provided. *Strojexport, Prague, Czechoslovakia.*

GEAR HOBBING MACHINE

Semi-automatic



THE OFP 20 machine is designed for the semi-automatic production of spur, helical, and worm gears up to 200 mm (8 in) in diameter and module of 4, by the hobbing method.

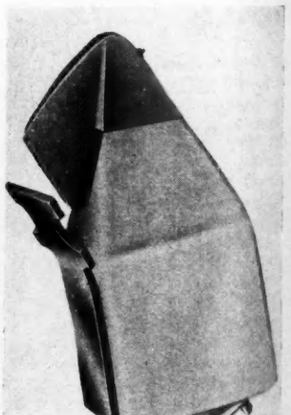
The programmed electro-hydraulic control of the work cycle, set up on the stops of a drum, enables economic production even when shorter runs are involved. To increase the life of the tool it automatically travels axially to ensure uniform wear of the cutting edges throughout the total length of the hob. When a large production series is involved, the machine can be equipped with a magazine provided with an automatic feeder and hydraulic clamping equipment.

The tool speed on a standard machine is changed in steps according to a geometric progression. However, infinitely variable spindle speed can be incorporated. The radial traverse of the hob slide and the axial traverse of the clamping table are made independently of each other and are infinitely variable. The drive is effected by hydraulic motors.

The stop system incorporated allows programming of the tool and workpiece at preselected speeds, feed rates and number of cutting passes, rough cutting or rough cutting followed by finish cutting, climb hobbing or conventional hobbing. Hydraulic control elements and pressure oil supply units are located in a separate cabinet. A signal light indicates blunting of the tool. *Strojexport, Prague, Czechoslovakia.*

HIGH FIDELITY PICK-UP

Calibration Standard



AN ULTRA-LINEAR professional pick-up, model 381, is designed to make precise measurements on gramophone records.

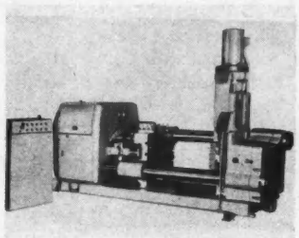
The 381 was produced specifically for recording channel calibration and radio station and record evaluation. It is now being made available for general use. In addition to the standard high-impedance model (47,000 to 100,000 ohms), low impedance models of 250 or 500/600 ohms are available. Response is flat within 1 dB from 20 to 10,000 c/s and within 2 dB from 10 kc/s to 17 kc/s.

The output of the head is stated to be 5 mV per channel, and channel separation is 35 dB. The weight of the plug-in unit is 12 gm. Recommended tracking force in a professional arm is 2 to 3 gm.

Various models are available. The 381 A includes an individual calibration test report and a 0·7 mil diamond "V-Guard" stylus. Model 381E Stanton calibration standard group includes two additional styli—a 1 mil diamond "V-Guard" for monophonic long-playing records and a 2·7 mil sapphire for 78 rpm records—each with a calibration test report. *Ad. Auriema Incorporated, 85 Broad Street, New York 4, New York.*

DIE CASTING MACHINE

Hydraulic Control



A DIE CASTING machine known as the CLP 400/55 operates semi-automatically with a maximum closing force of 400 tons and a maximum pressing force of 55 tons.

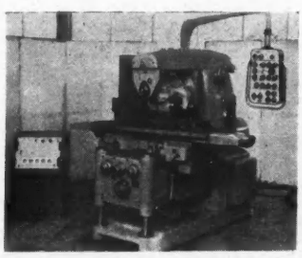
The maximum weight of metal poured in filling the machine's cylinder is 28 lb of aluminium, or 48 lb of zinc, or 33 lb of copper. The semi-automatic cycle, under electro-hydraulic control, can include a hydraulic ejector, up to four core drawers, brought into action simultaneously, and two further core drawers brought into action after the core drawers at the first stage have been drawn in, either before or after the machine is closed.

An important feature consists of the possibility of adjusting the nozzle position in relation to the machine axis. This is valuable when castings have an eccentric gate: the possibility of stepless change of the nozzle position permits the die to be clamped so that the machine centre axis always passes as close as possible through the centre of the casting area in the parting line of the die. This ensures safe closing. The stepless change is made possible by the ability to move the front frame vertically upwards.

The preselection of a particular working cycle is carried out by setting switches located in a separate control console. All operations are interlocked in such a manner that none of them can be carried out unless and until the preceding one has been fully completed, even if a possible defect occurs in the locking system. The time period of pressing and the time period during which the machine remains closed are controlled electronically. *Strojexport, Prague, Czechoslovakia.*

MILLING MACHINE

For Extreme Conditions



A NEW RANGE of milling machines, the FB 32, is designed for heavy duty milling with full utilisation of cemented carbide tipped tools.

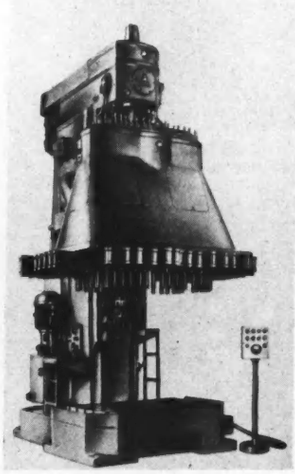
Particular attention has been paid to the main drive, the work spindle, and the machine frame. The entire driving mechanism is housed in the frame of the machine and is dimensioned so that the deformation of the driving elements is proportional to the expected machine rigidity. The work spindle is mounted on three anti-friction bearings; an NN 30 K double-row roller bearing at the front, and two tapered roller bearings at the middle and rear end. To damp torsional vibrations a flywheel has been built on to the work spindle.

All the main machine functions are controlled from a remote panel. Its upper part is reserved for control of the work spindle—start, stop, inching, and automatic engagement of spindle speeds, all by push buttons. The central part of the panel includes the machine feed control—start and stop of the table movement in all three coordinates, in combination with the working feeds, rapid traverses, and fine feeds. The lower part of the control panel is reserved for automatic cycles set into the panel, and for lowering of the knee. The machine can be modified for punched tape control.

Horizontal, vertical, and universal versions of the machine are available. Equipment for downcut milling is a permanent attachment. The clamping surface of the table is 315 mm by 1,400 mm, the feed motor being 2·2 kW. The spindle drive motor is rated at 10 kW and spindle speeds vary from 35·5 to 1,800 rpm. *Strojexport, Prague, Czechoslovakia.*

MULTI-SPINDLE DRILLING MACHINE

24 Heads



SUITABLE for drilling, counter-sinking, reaming, and tapping, the VM 4 will deal with up to 24 holes at once in large workpieces.

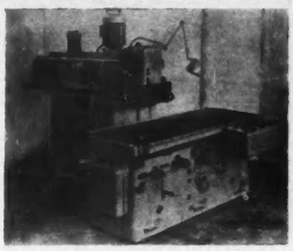
The headstock is moved hydraulically along guideways in the stand over a range of 17½ in, being balanced by a counterweight. The drilling spindles may be set over an area of 22 by 35¾ in, the minimum permissible distance between them being 1¼ in. Nine spindle speeds between 63 and 1,000 rpm are available. These are selected by means of two exchangeable pulleys, two pairs of sliding gears and three pairs of change gears in the drive box, and two pairs of sliding gears on each spindle.

The adjustable drilling spindles are fastened to slots in the headstock and can be moved axially by 1$\frac{9}{16}$ in by means of sliding inserts. In this way the changes occurring in length of the tools can be adjusted for.

The gearbox is arranged at the top of the housing, being driven through V-belts from an electric motor. Gearbox and headstock are lubricated by a circulating system. The housing is stiffened and carries hydraulic equipment on either side. *Strojexport, Prague, Czechoslovakia.*

SLOT-CUTTING MACHINE

Semi-Automatic



SEMI-AUTOMATIC slot-cutting machines in the FEA 3 range are intended for the precision milling of needle slots in flat needle plates of knitting machines.

The milling is effected in an automatic cycle controlled by stops and limit switches. Either a single saw may be used as the cutting tool or a set of saws built up to a length of 25 to 50 mm—or, if required, 1 to 2 in. Two different work cycles can be used on the machine, one giving the direction of feeds and rapid traverses in the reverse order to the other. The selection of the appropriate cycle is by a lever on the control desk.

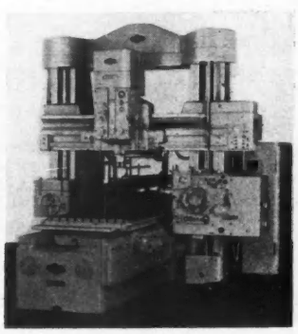
The nine speeds of the spindle are selected by means of two levers on the arm. The final shaft of the gearbox drives a camshaft with an adjustable safety clutch; in the event of the permissible torque being exceeded as a result of the tool becoming blunt or breaking, the clutch stops the feed motor, after which the spindle motor stops as well.

Vertical movement of the headstock is started and stopped by electromagnetic clutches controlled by stops. A positive stop safeguards the movement of the headstock to the exact depth of the slot. The arm itself moves crosswise in the guideways of the housing. Feed and rapid traverse are also controlled by stops.

The feed box has its own electric motor and is fitted with a system of electromagnetic clutches, forming the timing assembly for the cross movements of the arm and the vertical movements of the headstock. The table is fitted with a dividing equipment that moves it automatically one pitch of the slots or a complete width of a set of saws. *Strojexport, Prague, Czechoslovakia.*

JIG BORER

Optical Precision Setting



THE double-column jig borer, type WKV 100, is intended for drilling, boring, and milling, with a setting accuracy of 0·005 mm.

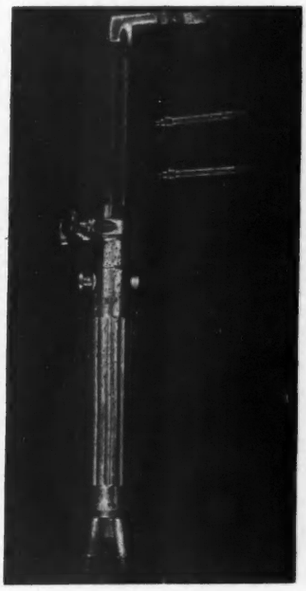
The range of applications of this machine is increased by the horizontal headstock and rest, and by a thread cutting attachment. The latter permits the cutting of male and female threads (metric and Whitworth) without the use of special accessories. Measuring and setting of coordinates is carried out by an optical system which projects a magnified image of a millimetre scale on a screen.

The vertical headstock is equipped with an individual electric motor of 4 kW power and contains the transmission and feed mechanism, spindle with quill, attachment for measuring the length of spindle out-feeding, and attachment for thread cutting—that is, an attachment affording a feed to the spindle that corresponds to the lead of the thread concerned. The transmission mechanism allows 23 speeds from 12·5 to 2,000 rpm; the feed mechanism allows 8 feeds from 0·025 to 0·63 mm per rev. An additional auxiliary headstock with a horizontal spindle is fixed to one column.

The work table of 1 by 1·6 m clamping area moves in roller guideways and is actuated hydraulically. Table feeds are variable from 20 to 350 mm per min. Both drilling motors when stopped are braked by direct current. *Strojexport, Prague, Czechoslovakia.*

CUTTING BLOWPIPE

Lightweight



WEIGHING only 12 oz, the "Firefly" hand cutting blowpipe can cut mild steel up to ½ in thick.

The handle of the blowpipe is an aluminium alloy extrusion, the body and head are manganese bronze stampings, the gas supply tubes are of nickel-silver, and the valve spindles are of silver-bronze.

The blowpipe is intended as the partner of the "Saffire" lightweight welding blowpipe. Initially, nozzles will be available only for use with acetylene; but an early introduction of a range of propane nozzles is planned. Forward mounted trimming valves are fitted.

The new blowpipe is designed on the latest nozzle mixing principles; the gases are fed to the nozzle through separate supply tubes so that gas is safe and resistant to backfiring. Three nozzles are supplied: the SM type for light gauge steel up to ⅛ in; a $\frac{1}{32}$ in nozzle for plates from ⅛ in to ½ in; and a $\frac{3}{64}$ in nozzle for plates from ½ in to ¾ in. *The British Oxygen Company Limited, Bridgewater House, St. James's, London, SW1.*

THICKNESS MEASURER

X-ray Absorption

THE Xactray equipment functions as a thickness measuring gauge for continuously monitoring the thickness of metal foil or plate.

Three basic elements are used: an X-ray generator, an X-ray sensor, and an electronic unit to compute the thickness of the material between the generator and sensor. A signal proportional to thickness deviation is available to operate automatic thickness control devices, recorders, or marking devices.

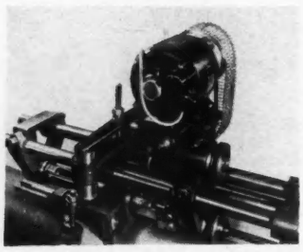
The generator and sensor are usually mounted on a steel C-frame, so that their distance apart can be fixed; this distance can be varied, depending on application, from 6 to 36 in. The frame may be mounted on wheels and equipped with a motor to allow positioning of the X-ray beam at any point across the material being gauged. Both units have been designed to operate under severe mill conditions.

The electronic console is preferably located in the motor room within 100 ft of the X-ray source. Positive filtered air pressure is, however, maintained within the cubicle to prevent entry of dust.

Metal standards are inserted into the X-ray beam for calibration purposes. They are enclosed in a sealed chamber directly above the source and are inserted into the beam by solenoids. Thus an operator at a remote position can select the thickness to be measured in increments as small as 0·0001 in. Normally a new thickness range can be selected in less than 10 seconds, including time for recalibration. Five models of the gauge give a range from 0·00035 in for aluminium foil to 2 in for steel plate, accurate to within 1 per cent. *Daystrom Limited, Gloucester.*

FINE BORING MACHINE

Portable



THE FM coupling fine boring machine has been designed for the finish boring of holes in coupling flanges and is ideally suited to applications where the working space available round the coupling is restricted.

Tapered diameters of the coupling shaft do not affect the mounting of the machine, since it is clamped to the periphery of the flange itself. The boring bar runs in high precision combined thrust and needle roller bearings, housed in steadying brackets located at each side of the flange, thus ensuring maximum rigidity.

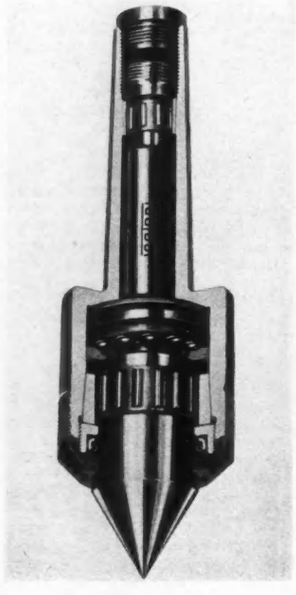
The tungsten carbide cutter is set to size by a micrometer that is supplied with the machine. Cutter sharpening is carried out on a built-in metal-bonded diamond wheel, using jigs to ensure correct cutting angles.

Stepped V-pulleys give a range of three boring speeds. The drive from the electric motor, mounted on top of the machine is taken through a V-belt, turned through 90° by gears, and then through another V-belt to the pulley on the boring bar. Automatic feed is also derived from the gears.

The standard FM machine is designed to bore parallel holes only and is supplied with a plain cylindrical boring bar. A taper boring unit is available as an optional extra and can be installed in the machine without any modification. In this unit the cutter is located in a carriage that slides on frictionless bearings along two guide rails which are pivoted at one end and angularly adjustable at the other. The sine principle is used to set the angle of taper. *Buma Engineering Company Limited, Robson Street, Newcastle upon Tyne 6.*

LIVE LATHE CENTRES

Tungsten Carbide Tips



LIVE lathe centres in the CT range are designed for heavy loads and high speeds.

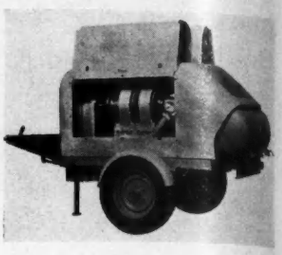
The rotating spindle is extended right through the tapered shank and is supported by two adjustable needle bearings that eliminate any vibration and chatter. Concentricity is to within 0·00008 in. All axial loads are carried by a heavy duty thrust ball-bearing.

A spring washer is fitted in the spindle to absorb thermal expansion of the workpiece and any shock loads such as occur in automatic copying operations. Protection of the bearings is provided by a built-in oil seal.

The slim diameter, by virtue of the needle bearings, and the cut-away body nose provide free access for tools. The largest centre in the series has a maximum diameter of 4·65 in and is capable of supporting a load of 13,000 lb at 50 rpm. Special shanks and point shapes can be supplied. *Insley Industrial Supply Company Limited, 21 Poland Street, London, W1.*

PORTABLE COMPRESSORS

Integral Construction



COMPRESSORS in the JW 440 KF range have the engine and compressor combined to form one integral unit, transmission being direct by way of the main and ancillary connecting rods.

Diesel engines are used to drive the compressors, both air-cooled and water-cooled models being available. The suction and delivery valves in the cylinder head of the compressor operate automatically, while the concentric location of the suction valve around the delivery valve provides an internal cooling effect. Further cooling is provided by the air or water jacket.

The compressed air leaving the high pressure cylinder at 100 lb per sq. in passes through an annular radiator to be cooled before reaching the receiver. A centrifugal blower fixed to the flywheel provides the air flow for this recooler.

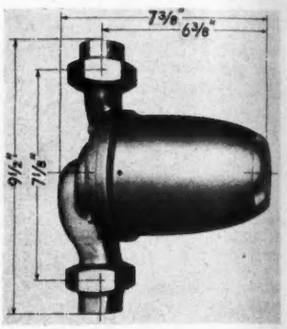
The air aspirated by the engine-compressor unit is purified in oil-bath filters. The volume drawn in is checked by a regulating valve controlled by the pressure in the air receiver. When the air chamber is fully charged, suction is stopped and the engine idles.

The compressor is started electrically, with the aid of a preliminary heater. A fuel tank of 9 gallons capacity is incorporated. The air chamber is a welded unit with a capacity of 5·2 cu. ft; its safety valve is set at 112 lb per sq. in working pressure.

The unit and all accessories are carried in a rigid welded frame with a single sprung axle. Overrun brake, hand brake, brake stop light, and lights for a number plate are fitted. *Chamberlain Plant Limited, Southbury Road, Enfield, Middlesex.*

CENTRAL HEATING CIRCULATOR

Water-Lubricated



ELECTRICALLY-DRIVEN, the NCP 2-50 pump is designed for circulating hot water in central heating systems.

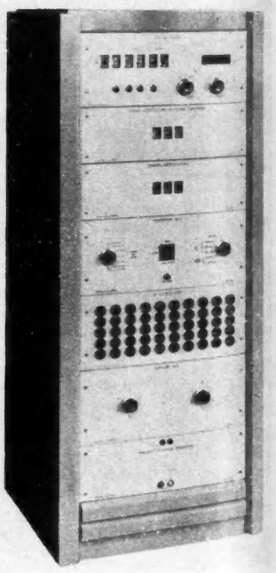
Two sizes of impeller are available for the unit. One will give 3 gallons per minute at a head of 5 ft; the other will give the same output at a head of 8 ft. Using the pump it is possible to extend existing central heating systems without enlarging the diameter of the pipework. The pump also speeds the warming up of a system and enables the best advantage to be taken of thermostatically controlled heating. It is especially suited to small-bore heating systems.

The motor used is a single-phase 60 W unit suitable for 200-220 or 220-250 V working. It is a capacitor-start squirrel cage unit. The rotor and the impeller are mounted on a common stainless steel shaft, which rotates in two water-lubricated bearings. The radial impeller is keyed on to the overhung end of this shaft and passages around the bearing at this end circulate water over the rotor to the other bearing. A stationary stainless steel sleeve contains this water, isolating the stator from the rotor and eliminating additional seals.

The complete unit is of totally-enclosed design, making it safe and dustproof. It has overall measurements of 7⅜ in by 9½ in and its compactness makes it simple to fit in most systems. Suction and delivery branches of the pump are equipped with 1 in BSP fittings. *Pulsometer Pumps Limited, Nine Elms Iron Works, Reading, Berkshire.*

DATA LOGGING SCANNER

1,000 Channels



DATA logger/alarm scanners are now available which will record the output of up to 1,000 measuring points at a maximum rate of 150 points per second.

The unit is available in a number of forms, adaptable to suit the situation where it is required. Any transducing element that gives a dc output signal can be fed into the equipment, while ac transducers and pneumatic transducers can be used with suitable converters. For most applications a three digit 0·1per cent analogue-to-digital converter is used, but a converter operating with accuracies within 0·01 per cent is also available.

Input commutation of the channels is by individual dry-reed sealed relays with gold plated contacts guaranteed for 10^9 operations. Input sensitivity is 10 mV (9·99 V full scale) without amplifier and 10 μV (9·99 mV full scale) with data amplifier. Alarm levels can be allocated to every channel or grouped. *Microcell Electronics Division, Blackwater, Camberley, Surrey.*

Uranium on Short Time

ABUNDANCE of uranium ore throughout the world is now known to be a fact and the results of prospecting continue to reveal further great deposits. As the larger countries, especially America, find that they have their own resources, their interest in importing this expensive commodity will wane. And the question that arises is what will happen to the large production that is coming from Canada and South Africa. Some companies will be grateful to be released from the stringent grip of the USAEC and will be able to close some of the mines that have proved to be unprofitable. Though 90 per cent of the uranium produced is used for military purposes, the civil power programmes will undoubtedly call for more uranium as they are extended. Meanwhile it is necessary to look for other fields to absorb the present rate of uranium production, which is one of the main reasons for the formation of the Canadian Nuclear Association (Atomic Review, 6 Jan. '61). It is to be hoped that by 1970 the world demand for uranium will have settled down.

Uranium Run Down

The South African Minister of Mines has announced that his country is prepared for a four year lengthening of deliveries of uranium oxide. There will be a drop in the uranium dioxide deliveries from 4,725 tons per year to 3,733 tons per year between 1961 and 1966, and then to 1,488 tons per year for the remainder of the period up to 1970. Britain, because of her economy, cannot afford to stockpile such an expensive commodity and has deferred taking her share until 1967, when she will receive 5,953 tons over a four year period. With the extension of the contract periods, the output required from the South African industry will be reduced by one-fifth over the period between 1961 and 1966 and the balance will be delivered between 1966 and 1970. In lieu of the former price arrangement, agreement has been reached on a fixed price for the total tonnage to be acquired by the United Kingdom Atomic Energy Authority and the United States Atomic Energy Commission. This procedure will enable each producer to receive a price related to that which it received before. The new agreements will enable a transfer of production to the more economical mines to be brought about by the Minister of Mines for South Africa after recommendations by the Atomic Energy Board; the reduction or cessation of operations by certain production units will follow.

USAEC Gives Further Orders to its Own Clients

An uranium concentrate contract between the United States Atomic Energy Commission and Susquehanna-Western, Inc., has been extended to 31 December, 1966. The contract provides that the United States Government shall purchase concentrates valued at approximately $47,000,000 from 1 June, 1960, to December, 1966. The uranium mill at Rivertown will operate at 500 tons per day, and will deliver 1,503,000 lb of oxide (U_3O_8) by 1 April, 1962, at a price of $8·635 per lb and 4,272,000 lb after that date at $8·00 per lb. Susquehanna also operates a uranium mill at Edgemont, South Dakota, and is building a new 200 ton per day mill at Karnes County, Texas. The original contract called for a total expenditure of $22,900,000 for uranium concentrate to be disbursed between 1 July, 1960, and 31 October, 1963.

Two Categories

The mine that is producing gold has a considerable cost advantage in the production of uranium over the mine that is producing uranium alone, since it is often possible to combine certain parts of the process. The result is a drop of about 35*s* per lb over the charge of approximately 75*s* per lb for the mines that are either unable or unwilling to combine the two processes. For the mines that are producing only uranium, it follows that they are going to have a rough passage over the next few years and Dominion Reefs, for example, have stated that they are withdrawing *in toto* from the uranium field and are selling out their rights.

Rich but Poor

A new uranium works is being built at Ranstad, Billingen, in Sweden, and will start operation in mid-1964, when some 850,000 tons of ore will be refined annually, yielding 120 tons of uranium. This quantity will be twice Sweden's needs at that date. Quantitatively Billingen is the world's richest source of uranium ore, but the uranium content at 300 gm per ton is among the lowest. In order to meet the United States price of 115 kr per kg, AB Atomenergi wants to receive the balance of this amount, about as much again, from the Government.

Fig. 1 Lead-lined gamma-ray source container with cover removed. The protective sphere which holds the source is turned to emit radiation. The container cannot be carried when the handle is in this position.

Gas Centrifuge Development

Although work continues on the gas centrifuge method it will take considerable time to iron out the associated problems, which at present prevent it from becoming popular in comparison with gaseous diffusion, thermal diffusion, and electromagnetic methods. The problems that need solving before a satisfactory process is possible are not simple and include:

(1) The reliability of the present machines, for continuous long-term service with uranium hexafluoride, must be proved.
(2) A model of a machine satisfactory for mass production of identical units must be developed.
(3) A method must be developed to provide for the introduction and removal of gas when the machines are grouped, as would be necessary in a production plant.
(4) The auxillary processes, services and instrumentation necessary for plant operation must be investigated.

The theoretical property, that the separative work performed varies with the fourth power of the speed, brings a heavy demand on the materials of construction and at present poses a severe limitation on the maximum speed.

Improved Research Programme

Development work was resumed on the gas centrifuge in 1953 in the United States after a break from the investigations made during the Second World War. It is now expected that the total USAEC expenditure on the development of the process will be between $2 million and $3 million per annum. Although the gaseous diffusion process is the most economical method of separation for the large scale production of uranium 235, the size is large and electrical power which the plant consumes is very high. In face of these points it is considered that the gas centrifuge has good possibilities. Other countries looking into these problems are the Netherlands and West Germany (Atomic Review, 21 Oct. '60).

Base Charges for Commercial Uses of Plutonium

The United States Atomic Energy Commission has established base charges for plutonium distributed by the Commission for commercial-industrial purposes. The base charges are equal to the fair prices which the Commission will pay for this material. The established fair price for plutonium delivered to the Commission prior to 30 June, 1962, ranges from $30 to $45 per gm, depending upon the content of the isotope plutonium 240; the fair price in the period 1 July, 1962, to 30 June, 1963, is $30 per gm ragardless of plutonium 240 content. No fair price has been established beyond 30 June, 1963. The base charge for plutonium of unspecified plutonium 240 content is $30 per gm throughout the entire period. Unlike fair prices, which are guaranteed during the above periods, the base charges are subject to revision by the Commission. Under the Atomic Energy Act, the Commission has title to all plutonium and other special nuclear material (uranium 235 and uranium 233) in the United States. The material may be distributed domestically under lease and may be sold or leased for use abroad. In cases where material is sold to foreign nations, the base charge is the sales price of the material. No base charge has yet been established by the Commission for the use of plutonium as fuel for nuclear reactors.

Notes and News

Gamma Ray Source Container

A new lead-lined container for gamma-ray sources is made by Solus Schall Limited, and is shown in Fig. 1. It is designed to hold 5 curies of iridium 192 or 2·5 curies of caesium 137. The lead shielding protection reduces the intensity of radiation at one metre from the source to 6 mr per hour. When the container is closed it may be carried by the handle, provided the padlock is in position. The weight of the container is 25 lb and the overall dimensions are approximately 6 in by 6 in by 7 in high. The isotope is removed by taking off a rubber pad in the centre of the back exposing the tungsten alloy plug, into which the source holder is fitted.

ML-1 Prototype Operates at Design Power

The Gas Cooled Reactor Experiment at the National Reactor Testing Station in Idaho has recently operated at the design power of 2 MW(t). The successful operation of the second core, which is smaller than the first, marks an advancement towards the final design of the ML-1. The second core, containing pin-type fuel elements, will permit the ML-1 to produce 300-500 kW of electricity for one year. The reactor and gas-turbine equipment may be transported in four packages totalling 38 tons. The reactor is designed to reach full power 12 hours after delivery, and may be removed 24 hours after shut-down. The second core has 55 fuel elements, each containing 19 pins, which are arranged in two concentric rings about a central pin. The pins are ¼ in diameter Hastelloy-X tubes loaded with a mixture of sintered uranium oxide and beryllium oxide pellets in the outer ring. The entire core is 22 in diameter and 28 in long. Both cores were developed for the USAEC by Aerojet-General Nucleonics. The ML-1 is sheduled for test operation next summer.

Short Bursts with FBR

A small research reactor designated the Fast Burst Reactor to provide short bursts of radiation for bio-medical and health physics research will be built at the Atomic Energy Commission's Oak Ridge National Laboratory (ORNL). The new reactor will consist basically of a core of uranium molybdenum alloy without shielding or moderator, since radiation exposure will be very small outside the limited access area. It will be located in a hollow enclosed by hills of sufficient height to provide adequate shielding for surrounding areas.

The FBR project, which is estimated to cost $1,400,000, will include the reactor, a building to house the reactor and accessory equipment, a storage vault and a separate control building. The control building will be located about 800 ft away, behind a ridge, to provide a shielded facility for remote operation of the reactor.

Fig. 2 Checking the regulating and safety rods and the drive mechanism of the AETR critical assembly prior to operation.

The reactor design provides for a pulse of 40 microseconds consisting of fast neutrons as free as possible of thermal neutrons. In addition, the reactor can be operated under constant steady state conditions at power levels up to 1 kW. The reactor will be operated from a special dolly at various heights up to 30 ft. Some experiments will be performed inside the reactor building while others requiring additional unobstructed space for certain measurements will be conducted in the open on a concrete apron.

Principally, the research programme will be concerned with radiation dosimetry in connection with instrument development and dose determinations and radiobiology programmes involving both large and small animals.

Critical Assembly for AETR

A critical assembly, shown in Fig. 2, has been built as part of the Advanced Epithermal Thorium Reactor (AETR) project being conducted for the Southwest Group by Atomics International. The assembly is a square honeycomb structure brought together in two sections to achieve criticality. The fuel is thorium and enriched uranium, which is inserted into more than 430 aluminium drawers in the machine. There are four safety rods and one regulating rod which contain fuel material and are mounted at the back of each section of the assembly; in order to shut the reactor down the control rods must be withdrawn. In addition, specially designed safety fuses are located in the fuel drawers. The research and development programme of the AETR will end in January 1963: it has not yet been decided whether a full-scale plant will be built. It would use sodium as the coolant and graphite for the reflector.

Gas Recycle System

The Morgantown gas recycle system, designed to study the technical feasibility of providing nuclear heat for high-temperature industrial processes, has recently operated at 2,500° F and a pressure of 250 lb per sq. in for 41 days. The programme's object is to develop suitable materials, components and heat-transfer processes for applying high-temperature process heat in the making of chemicals, plastics, metals and other products. In the facility, 2 in graphite spheres similar to those used in the pebble-bed reactor concept simulate fuel elements. The spheres are heated by electrical induction to approximately 3,000° F and helium gas at 250 lb per sq. in is passed over them. The helium heated to 2,500° F by the graphite spheres is then cooled to 1,000° F in a heat exchanger, which could simulate a chemical process unit or a high-temperature steam generator. A 23,000 rpm recycle compressor moves the helium through the system.

Plowshare Programme

Development of nuclear explosives for peaceful purposes is possible, allowing operations on an unprecedented scale to take place, for example, in

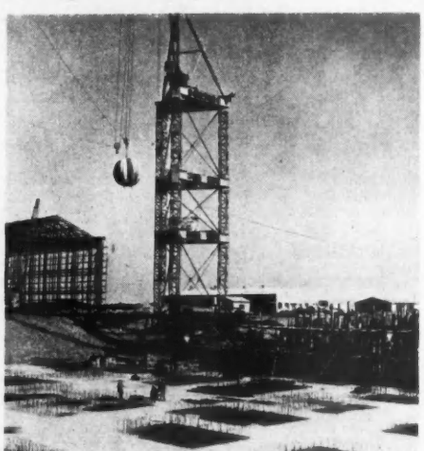


Fig. 3 To mark the inauguration of the second stage in the building of the 150 MW nuclear station at Tokai-Mura by the British General Electric Company of Japan Limited, a Shinto religious ceremony was held recently, during which pigeons and streamers were released from the papier-maché sphere shown here.

the release of oil in oil sands. Basic research at Los Alamos and Livermore indicate that elements of very high atomic number and some neutron rich unstable elements can be obtained in larger quantities by nuclear explosions revealing information of the nuclear structure of the artificial elements. "Project Oilsand" proposes to use nuclear energy underground to release large oil deposits trapped in oil-sand formations. Certain research is necessary into the radioactive contamination, the mechanism of heat distribution to release the oil in the cavity, cracking the oil and similar problems. The use of nuclear explosions for the removal of earth offers great promise with a cost reduction to a tenth of the conventional methods. In the case of harbour or dam building this would be important.

Reports Received

Commissioning Pluto: The procedures used for the safe loading of fuel into the high-flux reactor PLUTO for the first criticality and the first fully loaded core are described. ("Physics Measurements during the Commissioning of Pluto," by C. J. England *et al.* AERE-R 3155.)

High Pulse Discriminator: Using a transistor discriminator based on the Schmitt circuit, the factors affecting the pulse rise time and the threshold stability are examined with particular reference to the temperature variation of the threshold. ("Transistor Pulse-Height Discriminator," by L. Stanchi. AERE-Trans 855.)

Magnesium Data Manual: A compilation of the best unclassified data on the physical, mechanical and chemical properties of magnesium and some of its alloys, and the effect of irradiation on these properties has been made. ("Magnesium Data Manual." DEG Report 90R.)

Resonance Escape Probability: An approximate method for the evaluation of resonance escape probabilities and self-shielding factors in heterogeneous systems has been devised. Scattering by light elements which may be present in the fuel is taken into consideration. Resolved resonances are treated individually and there is good agreement with Monte Carlo results, but the estimate made of the unresolved resonances is not so good. ("Programme for the Evaluation of Resonance Escape Probabilities and Self-Shielding Factors in Hydrogen Moderated Lattices," by A. J. Taylor. AERE—R 3364.)

Thermal Waves Through Graphite: A self-sustaining thermal wave can only propogate through irradiated graphite in the presence of uniform cooling if the rate of cooling is less than some critical value. For typical graphite at 100° C the time constant for cooling is estimated to be about two hours. ("Propagation of Thermal Waves through Graphite with Uniform Cooling," by A. J. E. Foreman and A. R. Curtis. AERE—R 3500.)

Neutron Transport: An approximate but simple solution of the one velocity neutron transport equation in an infinite medium has been derived, and the numerical values of the total flux, obtained using the approximation, compare very favourably with the exact values. ("Approximate Solution of the One Velocity Neutron Transport Equation in an Infinite Medium," by G. Rowlands. AERE—R 3369.)

Reactor Notes

Peach Bottom Safety Aspects: The USAEC's Advisory Committee on Reactor Safeguards finds that the results obtained so far are favourable from the safety angle for the advanced high-temperature gas-cooled power reactor which the Philadelphia Electric Company and 51 associated utilities are planning to build at Peach Bottom. The 40 MW(e) reactor will use combined fuel-moderator elements containing enriched uranium and thorium carbide in an impervious graphite matrix.

Submerged for 67 Days: The NS George Washington has succeeded in remaining submerged for 67 days—7 days more than the previous record set up by NS Seawolf.

Britain's Second Nuclear Submarine: The contract for the design and manufacture of the main propulsion steam turbines and condensers for Britain's second nuclear submarine has been awarded to the English Electric Company. The submarine was recently ordered by the Admiralty from Vickers-Armstrongs, Barrow-in-Furness, and the "keel" (centre section) is expected to be laid soon.

Dresden shut down: After running for 27 days above 70 per cent load factor, the reactor was shut down due to the breakage of a tube connecting the drive mechanism of a control rod poison blade.

Companies

A Complete Unit in Vehicle Manufacture

THAT the LEYLAND MOTORS Company were taking the long term view in acquiring the STANDARD-TRIUMPH INTERNATIONAL car and light van concern last year was made plain at the time.

Now, in his annual report, Sir Henry Spurrier, the Leyland chairman and managing director, sets out some detailed thinking on the future prospect for the vehicle manufacturing industry, particularly the heavy side, on which Leyland fortunes have, up to the STI move, traditionally been founded.

The demand for maximum carrying capacity vehicles has remained fairly constant throughout the past year, while the demand for lighter vehicles has risen considerably, due to increased activity in constructional and civil engineering developments. Many of the firms specialising in this field have taken to ordering smaller, lighter, vehicles which can be obtained and put to work at short notice and can then be written off as a consumable item against a particular project.

There has at the same time been a growing demand for the heavy specialised vehicle, either wheeled or tracked, and also for the heavy dump trucks made specially for earth moving operations. In this market the competition is from the companies building equipment specifically for the constructional engineering industry.

An important side of Leyland's work, at home and overseas, is in the passenger carrying vehicle side of transport. Particularly in the home market, the company is having to face the effects of the ever-rising competition public transport is meeting from the private car.

"It seems doubtful," says Sir Henry, "whether we shall be able to look in the future for anything more than replacement orders as a contribution to our output for the market in Britain."

Overseas the prospect is brighter. In the developing nations bus services continue to expand. For millions of people this is a new service. With the steady rise in living standards transport by road is increasing in possibility, and in popularity.

The growing dependence of this side of the Leyland business on export markets is underlined by the rise during the year of overseas orders and deliveries to 60 per cent of their output, from 50 per cent at the start of the year.

Group turnover had also increased at home. The trading profit was up from £6,277,135 in 1959 to £10,441,514 in the financial year 1960. After excluding tax, depreciation and certain other items, the net profit over the year was £4,624,245, compared with the 1959 net profit of £2,685,630.

There has been a lively improvement in the demand for Leyland diesel engines for installation in "competitive makes of vehicles" and also for use in earth-moving equipment and as industrial units. Of the order book at the end of the financial year, the chairman reports that the number of unexecuted orders stands considerably higher than at the end of 1959.

On the Standard-Triumph International merger, the Leyland board, looking to the future, were not particularly influenced by the current depression in the British car industry. They expect an improvement "at a date not too far ahead," though no exact forecast is made.

In a letter to stockholders, Sir Henry Spurrier has stated that substantial losses are being made by Standard-Triumph and they are not likely to be made good by the end of the financial year next August. Later this year operation at a profit is expected.

Standard Motors complement the Leyland group's range of vehicles by manufacturing a number of cars and light commercial vehicles. The Leyland annual report mentions that at some time in the future there is the possibility of filling in the intermediate vehicle range. The overall view of the project is that it offers the promise of making possible the "ultimate organisation" and one which will be able to hold its own against the competition, in particular, from the United States and from Western Germany.

The likely time-scale of this operation is set out by Sir Henry as two years for the implementation of a large measure of the plans. With the development of products additional to the joint range, completion of the final picture could take around five years.

Machinery and Electrical Changes in United Africa

The machinery and electrical business of the UNITED AFRICA Company is being reorganised into a separate group which will include a London company to be called UNITED AFRICA MECHANICAL AND ELECTRICAL Limited (UNAMEC).

The function of the company will be to provide for its overseas associates, and the other parts of the United Africa group, buying and advisory services in connection with machinery and equipment, electrical supplies including radio and television, and refrigeration and air conditioning equipment.

The overseas elements of the new group will be: in Ghana and Nigeria—UAC (Technical), Pan Electric, Ghana Consolidated Machinery and Trading, and Ghana Pan Electric, together with certain service organisations; in Kenya, Uganda and Tanganyika—the machinery division and domestic electrical interests of GAILEY AND ROBERTS.

"Pre-Engineered" Buildings for the Far East

One of the United Kingdom's companies most closely associated with the economic development of the emerging nations around the world is COSELEY BUILDINGS, of Wolverhampton, whose prefabricated steel buildings are particularly applicable to the problems of lands without developed resources of skilled builders or equipment producing industries.

The necessity of swiftly erecting site offices and accommodation for projects in industrialised states—and the almost complete availability of the components of the company's structures for re-use in the next buildings—have guaranteed additional markets in the wealthier, more advanced, markets.

A six months' tour in the Far East which the director of Coseley Buildings' international organisation, Mr. Ion Lane (inset) has begun will take in a range of markets that indicate where the company sees at least part of its next round of opportunities. Ion Lane will be visiting Singapore, Malaya, North Borneo, Sarawak, Brunei, Viet-Nam, Thailand, Dutch New Guinea and the Phillipine Islands.

It is not only in offices, houses and schools that the "pre-engineered" buildings find their outlet. In the Middle East and North and West Africa a variety of constructions have been used for veterinary check points, net-drying sheds for fisheries, tea and rubber handling factories, telecommunications stations and workshops for mechanical engineering.

One of the largest contracts on which Ion Lane has worked gives an indication of the size of schemes for which prefabricated buildings are put to use. This was an order, worth over £750,000, for two self-contained townships in the middle east. They included industrial plant and workshops, living quarters and houses and amenities such as cinemas, bowling alleys and all kitchen equipment.

Telling the World What You Do

The presentation of themselves and their activities essayed by companies of all sizes and products goes on increasing in complexity and in standards of presentation. Two of the most recent, and the most notable, departures have been DAVY-UNITED's superb book *Built by Davy-United*, and the PRESSED STEEL Company's new *Picture Press*, which promises to be something of a super house journal.

Through almost 100 finely illustrated pages, Davy-United, now part of the DAVY-ASHMORE Group formed last year by the merger of Davy-United with the POWER-GAS Group, portrays and describes unit after unit of the heavy engineering equipment it has sent round Britain and the world.

A great deal of the equipment has gone into the fast growing capacity of the British iron and steel industry, but the tale is also told of valuable orders executed for steelworks in Europe and further afield. For A/S NORSK JERNVERK, at Mo-i-Rana, in Northern Norway, there was the 42 in by 108 in high-lift reversing blooming and slabbing mill which forms the primary unit of an integrated steelworks. All the initial rolling mill and auxiliary equipment, some 8,500 tons of machinery, came from Davy-United.

This blooming and slabbing mill can roll square ingots up to 4½ tons and slab ingots up to 12 tons, in outputs up to 650,000 tons in a year of 6,000 working hours.

A judicious use of colour, for drama and for better explanation, is employed in *Built by Davy-United*. Shown in colour is the 15 in and 32 in by 36 in 4-high cold intermediate breaking-down mill installed in the Kynoch Works, Witton, of Metals Division of IMPERIAL CHEMICAL INDUSTRIES. This breaking-down mill receives surface milled hot rolled flats of both brass and copper weighing 2,000 lb, which are transferred to the ingoing roller table by a vacuum cup lifting device.

Considering Pressed Steel and the Side Effects

For *Picture Press* the side effects of industry, social, academic and so on, are just as much grist to the editorial mill as the products and internal affairs of the PRESSED STEEL Company.

If a prestige journal is good enough, it may sometimes get out of the In and Out trays of the office desk and make its way to the executive's home. If this one does, then the food correspondent of the London *Observer* has put down some suggestions that will certainly bring variety to the evening meal.

In a special section devoted to Oxford—for which, by reason of location, the company has a special interest and affection, three contributors have written on the university, the "dual-community" of major modern industry and the historical old academic city, and on Oxford as a production centre.

The third of these writers was Mr. E. P. Ward, Deputy Editor of ENGINEERING. He emphasises two points of particular interest to the people of Oxford. One of Pressed Steel's problems at Oxford has been the acute shortage of skilled men. Getting down to tackle the problem itself, Pressed Steel are in the process of constructing their own large new apprentice school. Potential shortages of foremen and managers are being dealt with by selective recruitment and an intensive programme of executive development. An interesting five year inquiry has been conducted into "management inventory" in order to find an answer to the problem of managerial obsolescence.

Pressed Steel has recently been making a splash with its organisational moves for the development and exploitation of light flying, for business or pleasure, in Britain and abroad. Its own acceptance of flying on business is described by the personnel director as "to make our present executives go round."

Any economist can point out that the company with only one outlet for its product is heading for trouble. From the first step of becoming independent of the MORRIS company, PS have widened their customers to include Rootes, Rover, Rolls-Royce, Jaguar, Jensen, the Swedish Volvo firm, and of course BMC, with specialist work for Ford, Vauxhall and others.

If this is still only the same industry, it is worth adding that there is the Prestcold refrigerator business, railway rolling stock in quantity from Linwood, near Paisley, Scotland, and of course those future aircraft.

The Deriaz Reversible Pump-turbine

The spirit of cooperation between manufacturer and user when the first machine was installed kept development time down to only four years.

ALONG the hard road of technological development milestones of exceptional significance will occasionally be passed. Any such sudden forward leap is most likely due to a fundamental change in conception, instigated by an impasse having been met in the previously established line of development.

Such a milestone is the Deriaz reversible pump-turbine. The fascinating story of how it came into being is inseparably associated with the English Electric Company and the development of effective power output from the Canadian Niagara Falls.

The newcomer owes its name to its inventor, Paul Deriaz, a Swiss engineer who joined English Electric in 1922 and who has just retired from the position of chief designer of the company's Water Turbine Department at Rugby. In this capacity one of his major achievements was the conception which led to a new word being added to the engineer's vocabulary, along with Pelton, Francis and Kaplan.

Electrical power reserves which can be made available at very short notice are becoming increasingly vital. With demand for plants capable of catering for low head factor operation, production of electricity by means of water stored by pumping and fed later to hydraulic turbines is an attractive proposition. There is also a call for "spinning reserve" capacity where generating capacity can be brought into action rapidly; a unit which can change from part to full load in a matter of a few seconds is of value to the system.

In 1951 English Electric installed three Francis turbines at Castello-de-Bode, in Portugal, to work under a head of 300 ft (max.). The type of operation demanded of these machines made Deriaz acutely aware of the limitations of the Francis and Kaplan turbines generally employed in hydroelectric schemes. The Francis, dating back to about 1870, has a fixed blade runner which makes no concession to fluctuating requirements. To develop maximum efficiency the Francis must run at about $\frac{7}{8}$ of full load. In service some units may have to be run at only a fraction of their capacity or even as "spinning reserve," and their efficiency under these conditions is very low.

In the Kaplan, devised in 1913 by a professor

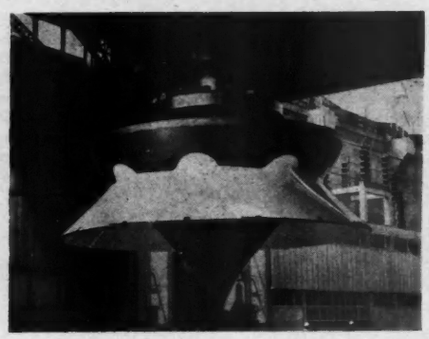


Fig. 1 Deriaz wheel with its blades closed.

of that name, variable pitch blades are used in combination with an axial flow turbine runner having a specific speed about $2\frac{1}{2}$ times greater than the Francis. The Kaplan improves on the efficiency of the Francis, particularly over the load range from 30 to 70 per cent, but suffers a severe limitation in head. While the Francis can be used for heads of up to 1,500 ft and more, 200 ft is about the practical limit for the Kaplan beyond which insurmountable mechanical and hydraulic difficulties are encountered.

Early in 1952 Deriaz decided to tackle the problem of applying the variable pitch characteristic of the Kaplan to the greater heads associated with Francis machines. The first hydraulic requirement was a reduction in specific speed from that of the Kaplan, chiefly to prevent cavitation. This is reflected by the reduction in radial expanse of the leading edge of the turbine blades, which led to the blades being positioned obliquely, as shown in Fig. 3. With this arrangement a centrifugal force component tends to counteract the effect of head.

The mechanical difficulties in a Kaplan turbine centre around the shape of the hub and the internal space available to accommodate the blade pivot bearings and feathering gear. The bearings in particular have to be made as large as possible due to the enormous hydraulic forces acting on the blades. The conical hub shape that Deriaz adopted suited this condition perfectly, and also permitted the use of much longer blade control levers, better proportioned to blade length and giving a more positive action.

A further advantage of the "feathering Francis" wheel, as it was first known, is that the blades can be designed to close completely along the whole of their width, see Fig. 1. This facility is fundamentally impossible with the Kaplan arrangement and the advance with Deriaz' design was one of the factors which was soon to lead to development of the new machine as a reversible pump-turbine.

By the autumn of 1952 Deriaz was ready to construct the first experimental turbine. It was fitted in a spiral casing with stationary and movable vanes and a conventional draught tube, and proved Deriaz' theories experimentally.

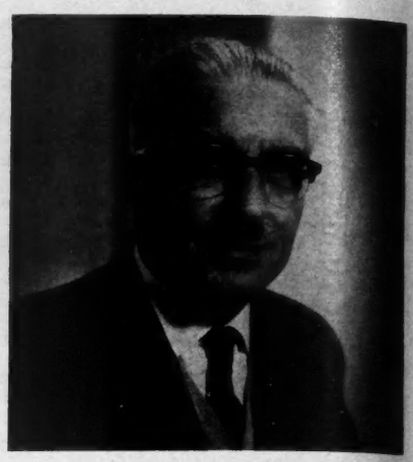


Fig. 2 Mr. Paul Deriaz.

NIAGARA

So far the development of the Deriaz turbine was of a speculative and purely experimental character. But in the spring of 1953 English Electric were invited to tender, in association with their Canadian subsidiary, for Hydro-Electric Power Commission of Ontario's "pumped storage" project upstream of their Sir Adam Beck No. 2 generating station then under construction at Niagara, thus entering the field of the reversible pump-turbine. This decision triggered off one of the most fascinating bursts of development in engineering history.

Initially a conventional pump-turbine was proposed for the Ontario Hydro scheme, based on a development of the Francis wheel of the type employed in centrifugal pumps. The idea was to use the same impeller permanently coupled to a combined motor-generator, to act as a motor driven pump for raising the reservoir level, and also as a turbine driven generator by allowing the level to fall. Previous general practice in "pumped storage" systems had been to connect a conventional pump to the lower end of the vertical turbine runner shaft through a coupling that permitted disconnection while running as a generator. Using one runner for both duties results in a far simpler arrangement, and limited application of single runner reversible units provided sufficient experience to support Ontario Hydro's specification.

A characteristic feature of most pumped storage systems is the head variation that must be tolerated, and Ontario Hydro's conditions

Fig. 3 (below) Comparison of three main types.

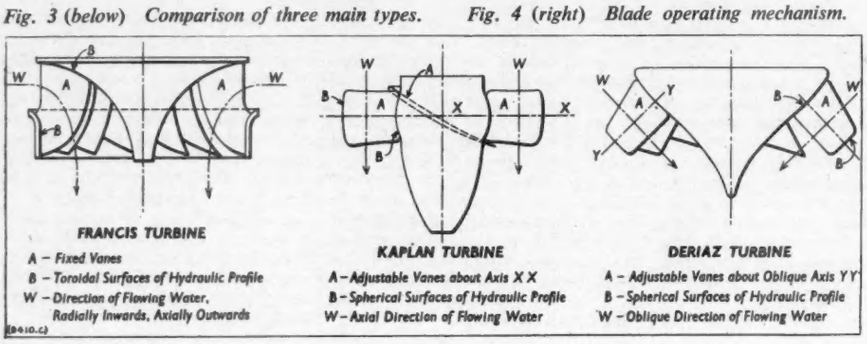

W
B
A
X
Y
FRANCIS TURBINE
A – Fixed Vanes
B – Toroidal Surfaces of Hydraulic Profile
W – Direction of Flowing Water, Radially Inwards, Axially Outwards
KAPLAN TURBINE
A – Adjustable Vanes about Axis X X
B – Spherical Surfaces of Hydraulic Profile
W – Axial Direction of Flowing Water
DERIAZ TURBINE
A – Adjustable Vanes about Oblique Axis Y Y'
B – Spherical Surfaces of Hydraulic Profile
W – Oblique Direction of Flowing Water

Fig. 4 (right) Blade operating mechanism.

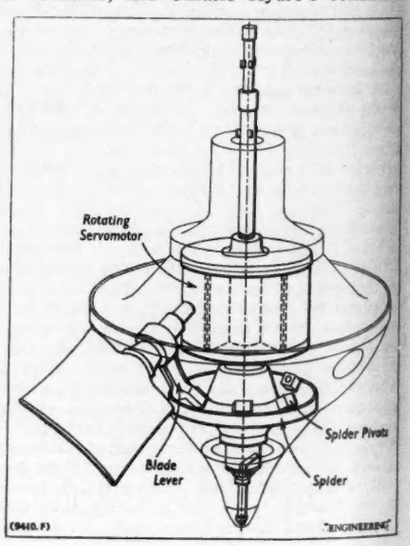


Fig. 5 To the three basic types of water turbine a new one is added.

were particularly severe. In the pumping sequence the head limits are 59 and 90 ft, and in the turbine cycle 38 ft and 88 ft. Deriaz suggested that a mixed flow pump-turbine runner with oblique adjustable blades might offer real advantages. Accordingly English Electric's tender included both types, and research to meet Ontario Hydro's conditions proceeded in two directions simultaneously. Ontario Hydro were sceptical of the newcomer at first; a natural customer reaction when faced with something absolutely new and untried. But they were prepared to give the Deriaz every chance. Had they not adopted this courageous policy, who can tell how long the world would have had to wait for commercial introduction of the Deriaz turbine?

Accordingly, English Electric started developing a wheel for Niagara, closely watched by Ontario Hydro. Gradually their interest switched from the conventional to the Deriaz pump-turbine. Step by step the experimental work at Rugby went on as attention became focused on the Deriaz. When Ontario Hydro placed the order on 1 July, 1954, after a year of intensive research, it was for six Deriaz units. The rating of these machines was 45,000 hp as a turbine and 55,000 hp as a pump delivering 4,600 cusecs (about 130 tons of water every second) against 75 ft head. The runner speed was to be 92·3 rpm in either sequence.

CONTROL

The Deriaz was found to possess many advantages over the fixed-blade pump-turbine, the most important being its ease of control, especially at starting. A pump-turbine rotates in opposite directions in its two roles, a reversal which involves starting from rest each time. The motor-generator is usually of the synchronous type to provide high load capacities, and this gives a low starting torque. A conventional pump must therefore be " unwatered " to give a no-load condition for starting, which is done by injecting compressed air into the pump until the wheel is out of water. The Deriaz wheel does not require unwatering, since with the blades completely closed the torque required for starting as a pump is only a small fraction of the full load torque. No compressed air equipment is therefore required.

Another incidental advantage on this particular contract was in the size of the units for transport, the six units being substituted for the original eight, the with same total output.

An ingenious modification to the original design was made at one stage, to meet the very special requirement of high discharge under minimum head in the turbine sequence. The conventional guide blades were dispensed with and the diffuser was enlarged and fitted with 6 two-position variable flaps, each controlled by an oil pressure servomotor. Control of the diffuser flaps is automatic from headwater and tailwater sensing devices.

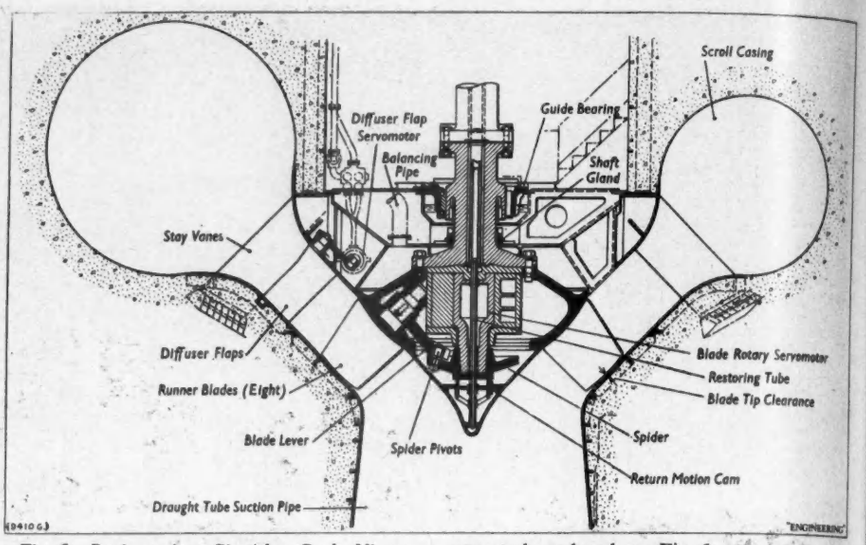


Fig. 6 Deriaz unit at Sir Adam Beck, Nigera.

Within less than three years of the order being placed all the detailed design, manufacture and delivery of the first Deriaz unit had been completed. It went into commission in May, 1957, and the others followed until all six were operational a year later. No teething troubles were encountered; indeed, the day the first unit went into service was almost disappointingly unspectacular.

A Deriaz wheel is a unique combination of size, weight and manufacturing precision of its components. The Niagara units were made in Canada except for the blades themselves which were machined and ground by English Electric in this country at their Netherton Works, Liverpool. To give an idea of size, the extreme blade tip diameter is 22 ft, the bare hub weighs 55 tons and the complete rotating element 127 tons. Special handling methods had to be devised in the shops as so many of the machined parts were too big for normal procedure.

OPERATION

Ontario Hydro have never regretted committing themselves to a Deriaz installation. In a paper read to ASME in December, 1958, Mr. A. E. Aeberli of Ontario Hydro listed the benefits that have been proved operationally as follows:

(1) The ease of starting up and shutting down is particularly valuable since four starts and stops are required daily. Pumping is normally carried out for 7½ hours at night, and generating during the daytime load period.

(2) With the impeller blades closed the generator-motor can be started direct-on-line.

(3) Since the blades alone control the discharge of water in either sequence, the conventional guide vanes and shut-off valves have been omitted. Leakage of water past the blade tips when idle is minimised by means of a movable thrust bearing which allows the blade tip clearance to be reduced, see Fig. 6.

(4) Opening or closing the blades can be performed at will over the whole range of blade angles with no apparent vibration.

(5) An important fringe benefit is the degree of overload that the Deriaz units will accept, in the region of 30 per cent. Furthermore, the ease of control and flexibility of operation lends the whole pumping-generating station particularly suitable for remote operation by computer.

Compared with other varieties of product which ENGINEERING have treated under the heading " Product Profile," water turbines are not in any sense quantity produced. So the success of the Deriaz cannot be measured in terms of numbers sold, although it is plainly evident. English Electric, still less Mr. Deriaz, certainly did not envisage the snowball development to come when investigations first started, and the costly development period has already amply repaid the company.

The Canadian Niagara project (as opposed to the American) has focused attention on the Deriaz machine, and the next installation is due to commence operation at Valdecanas, in Spain, during 1962. The three Deriaz units there are again designed for reversible application but under quite different operating conditions. They are slightly smaller but have a pump rating of 110,000 hp each against 240 ft head.

Another Deriaz unit of 32,500 hp for turbine only is in process of manufacture in Scotland for the Culligran Power Station of the North of Scotland Hydro-Electric Board.

The company have plenty of inquiries on hand, and pumped storage is becoming more generally accepted all over the world as a means of catering for a daily cycle of load variation work for which the Deriaz is particularly well suited.

What developments are immediately in view for the Deriaz, which is still right at the start of its career? Certainly present studies are being directed at increasing heads, in order to enlarge still further its sphere of application.

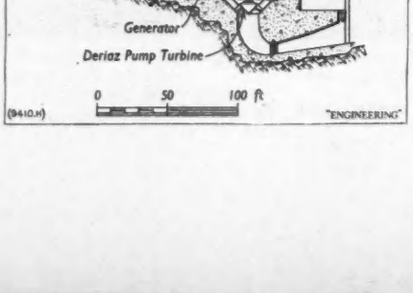


Fig. 7 (left) Section through Sir Adam Beck pumping-generating station.

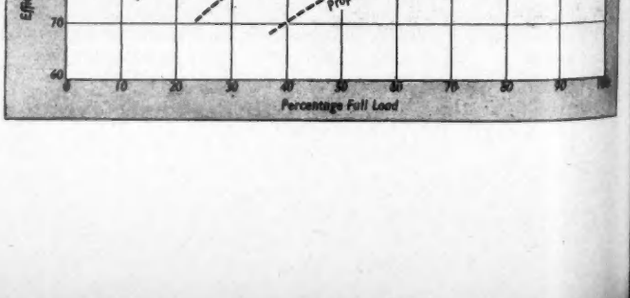


Fig. 8 (right) Comparison of turbine efficiencies.

Summarising Safety Belts

Measures to reduce the risks of of motoring are currently before the House of Commons, helping to sustain public interest in the safety harness and prompting this review.

TODAY the Motor Vehicles (Passenger Insurance) and Road Safety (Protective Headgear) Bills are due to receive their second readings in the House of Commons. The concern of our legislators for the safety of motorists is more than equalled by the practical interest of manufacturers, who have recently been giving considerable attention to the problem of protecting the driver and his passengers.

In Automobile Review last 2 December Mr. John Rabson examined the ways in which car designers were helping to minimise the possibility of accidents; and on 9 December, he described equipment and accessories designed to reduce the risk of injury if a crash occurred. Lately the makers of safety belts have been particularly active, and a survey of recent news may help to bring the subject up to date. Descriptions of particular models will appear in a later issue.

British Standard Protection

"Seat Belt Assemblies for Motor Vehicles" is the title of a recent British Standard Specification B.S.3254: 1960. It defines the criteria which most safety-strap designs now satisfy. The British Standard Institution point out that "under certain accident conditions, assemblies which also provide restraint for the upper part of the body will give increased protection for front seat passengers." Although the standard does not specify requirements for anchoring the webbing, it defines the basis on which the belts or harnesses, including any reinforcing plates, are tested.

Tests are grouped under the following headings: (*a*) tensile strength and elongation of the webbing; (*b*) buckle slip under load; (*c*) buckle release load; and (*d*) the load carrying capacity of the entire belt or harness assembly under static loading conditions. It is assumed that the wearer weighs 200 lb and the accident conditions are such as to impose a maximum loading on the assembly equivalent to twenty times the weight of the wearer (corresponding to an acceleration of 20*g*) along the longitudinal axis of the vehicle; in other words a force of 4,000 lb.

Lap or body strap webbing is to be at least 1¾ in wide and should not break at a load of 3,000 lb; corresponding requirements for shoulder harness webbing are: width 1⅜ in and load 2,250 lb. Elongation is to be less than 25 per cent under loads of 2,250 and 1,375 lb for lap and harness webbing respectively. The buckle, which should not be capable of partial engagement and should be of quick-release pattern, must be corrosion resistant, since the emergency may arise after several years of accident-free travel. Belts or harness meeting the test requirement display the certification (kite) mark of the British Standards Institution.

Test Results

Tests based on the British Standard requirements have been conducted by the Institution's Consumer Advisory Council and the results published in *Shopper's Guide* (No. 17, November 1960). It is pointed out that a car travelling at 30 mph which is brought to rest in 30 ft imposes on the passengers forces equivalent to their own weights. An impact that stops the same car in 4 ft results in a force eight times the passenger's weight; while the maximum force that even a strong man can resist by bracing himself is three times his own weight.

A driver might be afraid that in the event of fire a safety belt would represent an additional hazard. But to reassure him the Council quote the Road Research Laboratory, who have not encountered one case of fire in 500 accidents investigated. On the other hand, the United States Committee on Road Safety has estimated that 52 per cent of all deaths in car accidents and 54 per cent of serious injuries cauld be prevented by the use of adequate restraining devices.

The Council list four main types of restraining device: hip belt alone, combined hip belt and one shoulder strap, complete harness (that is belt and two shoulder straps) and a diagonal cross strap. Waist belts, as distinct from hip belts, are rejected on the grounds that they may cause internal injuries. It is emphasised that the anchorage, like the straps themselves, should be able to withstand a force of at least 4,000 lb, and that seats (which are seldom rigid or firmly fixed) are unsuitable for this purpose. A minor point but an irritating one—the colour should not rub off belts on to clothing. Of the twelve assemblies tested, four failed; none of these four or their manufacturers are mentioned in this article. It is also apparent that an acceptable belt or harness costs at least £3 and perhaps as much as £13.

Safety straps, according to the Council, not only reduce the risks of motoring, but also make for restful travel, for example, by reducing the need to brace at corners. They also serve to unite the driver and his car providing a more positive reference datum than the traditional seat of his pants.

Recommended by the Best Authorities

After a thorough investigation by its technical experts, the Royal Automobile Club stated recently that it recommends all motorists and car passengers to wear properly installed safety harness. The RAC emphasise that a firm and reliable anchorage for the belt to the actual framework of the car is absolutely essential. Seat-belt attachments should be properly installed preferably by a skilled mechanic in accordance with manufacturers' instructions. The Minister of Transport, Mr. Marples, has declared that all British manufacturers may soon fit attachments for safety belts in new cars.

International Safety Belt Conference

A conference described as the inaugural meeting of the International Safety Belt Association was held in London on 10 January. Although safety belt manufacturers from Norway, Denmark, Sweden, Finland, Germany, Switzerland, the United States, and this country, were said to be represented, most of the principal British manufacturers did not attend. It was stated that in Sweden 60 per cent of cars were equipped with safety belts, whereas in Britain the figure was nearer one in a thousand.

Manufacturers' Committee

At a meeting held in London on 19 January a committee representative of British car safety belt manufacturers was formed. Its objects are: To discuss common issues affecting public safety; and in particular to ensure, in cooperation with the British Standards Institution, the effectiveness of car safety belts and harnesses, and to guide public policy and opinion in favour of their use. The following manufacturers are represented on the committee: Autosafe Limited, Britax (London) Limited, Delaney Gallay Limited, Irving Air Chute of Great Britain Limited, Mitchell, Ashworth, Stansfield and Company Limited (makers of the Masco-G belt), and Michael Richmond Limited (in conjunction with Siebe, Gorman and Company Limited). The GQ Parachute Company Limited which is not as yet producing safety harnesses specially designed for ordinary cars, is not represented but has indicated its sympathy with the committee's objectives. Mr. A. de L. Maufe (Michael Richmond Limited) has been elected as the committee's first chairman.

Four basic patterns: (top left) hip belt or lap strap (Irvin), (top right) combined hip belt and shoulder strap (Richmond), (bottom left) complete harness (Masco), and (bottom right) diagonal strap (Britax).

Safety Screen instead of Safety Belt

An alternative to the safety belt has been put forward by a Belgian engineer. In the event of an accident or at the instant of violent braking, motorists and their passengers may be protected from serious injury by a shock-damping screen which automatically springs into position just in front of the windscreen. Monsieur A. J. L. Bioul of Chatelet, Belgium, also points out that the unit, which fits on to the dashboard of any car, can also be used as a lever to assist driver and passenger when getting in and out of the vehicle; in this way it overcomes many of the objections so often raised against safety devices. The unit could be made to operate in several different ways but in one version it consists essentially of a screen wound round a vertical spindle against the action of a spring. Actuated by pressure or electrical contact at the passenger's feet, hands or elsewhere, the screen springs into position so that the full force of the forward moving passenger is taken on the resilient screen rather than on the glass windscreen. (A. J. L. Bioul, British Patent 851,803.)

Research

The Motor Industry Research Association is investigating outstanding problems in connection with safety belts. Among these is the question of anchorage; many harnesses still depend on the rigidity of seats even if anchored to the floor behind. The association is also reported to be studying the "packaged" characteristics of cars. An article in *Design* (January, 1961) suggests that studies should be carried out on the use of passenger restraining nets from roof to floor behind the front seats.

It is apparent from correspondence in the same journal that further research is required into the question of car design in relation to the safety belt: in particular regarding the anchoring and locating of straps (hinged and adjustable seats may be prevented from operating); the direction of body movement under impact (an open car may allow a passenger to be projected clear, whereas he might be crushed under the car if restrained); and comfort. These problems can only finally be studied statistically and in the field, a conclusion which has disturbing implications.

But in any case, there can be no real hope for the safety belt, for reasons of mechanical and human weakness, until the motor car designer applies his talents to the problem.

On the Shelf

By Frank H. Smith

I CAN see all sorts of snags ahead if A.P.H.'s brainchild, the Libraries (Public Lending Right) Bill goes through. I shall expect public libraries to keep tabs on anybody reading The Shelf in the reading room and, on a larger scale, ENGINEERING should have a rake-off from anybody taking the journal off the rack. And if public libraries, why not semi-private societies' libraries? Then we come to the reference library that lends from its shelves but does not keep a separate loan collection. And if a library service is part of a member's privileges must they pay blood-money? If not, because it is a member's privilege why should the ratepayer pay extra for *his* privileges? As a matter of fact, I do not mind who reads this column, whether they have bought or borrowed or scrounged the copy. I enjoy writing it and since I have been doing so I have not had a single boil or wicked thought. That's what sublimation does for you.

Anybody seeking to complete runs of unusual (or usual for that matter) periodicals may like to try Scientific Book Supply Service Limited, 10 Birkbeck Hill, London, SE21. They sent me about 20 pages of duplicated items that I have never heard of in some cases.

Lynge and Søn of Løvstraede 8-10, København K. (Copenhagen to you) have issued their catalogue "From Lynge's Shelves No. 232" which, while dealing chiefly, bookwise, with applied physics and chemistry, biochemistry, and pharmacology, also has a collection of periodicals. Old faithful is there, volumes 57-59 and 61-66 for 100 Danish krøner.

The charm of this column is, of course, the unexpected. Moving from on the shelf to in the cellar, I have had a buckshee copy (and you can have one too) of *The Wine Mine* put out by Peter Dominic (Aux Caves de France, Horsham, and 2-8 Orange Street, London, WC2). This tells you a lot about wines (which are very U nowadays) in a chatty and humorous fashion and gives you some idea of how much it will cost you to throw a convivial evening. The poetry of wine names puts this almost alongside Palgrave.

Gregg Associates, of 52 rue du Progrès, Bruxelles 1, offer a service for reproducing old books (in quantity) which they claim is worthy of consideration when reprinting is not justified. I do not pretend to understand the technicalities but figures given (for a 200 page 8vo book) range from 9*s* 2*d* per book for 100, to 1*s* 8*d* for 5,000 copies. If this tickles your curiosity and you drop them a line, I feel I've done my bit.

Though I do not deal from them I must give credit to The Times Bookshop technical division (Wigmore Street, London, W1). They have so far kept me very well primed and supplied with lists and circulars but I expect they will drop off a bit when they get no response. One must be loyal, I think, don't you? (rhetorical). How do you like that Godfrey Winn touch?

FBRAM is not a meat product but the Federation of British Rubber and Allied Manufacturers (43 Bedford Square, London, WC1) and from them you can get a free copy of "Guide to the Drafting of Specifications for Rubber Products." A copy by your side should save you too much use of the eraser.

Had a packet the other day that was a nice exercise in detection. The label on the outside was from a firm Ex Libris, Buchhandelsgesellschaft, Frankfurt. This was a secondhand piece of wrapping paper and on the inside was a label from Hermann, 115 Boulevard Saint-Germain, Paris. Inside this was a cardboard carton from the Société Royale de Botanique de Belgique Jardin Botanique de l'Etat, Bruxelles. The contents of the parcel was a book sent out, in the first place, from London. Books do get around.

Pictures Through a Microscope

The Technique of Photomicrography. By DOUGLAS F. LAWSON. *George Newnes.* (55*s*)

The early pioneers of microscopy were handicapped not only by imperfect lenses, but also by the difficulties of recording the images they saw through their instruments. Artistic skill of a very high order is necessary to reproduce faithfully the microscopic details of a leaf section or an insect. In spite of this, many important discoveries were made and, when reading the old books on botany or zoology, we marvel at the skill and infinite patience which we know must have been entailed in producing the illustrations.

The invention of photography made it possible for the first time for anyone to record faithfully everything he could see through his microscope. In the early days the technical difficulties were, however, still great, due principally to the slow speed, imperfect photographic materials available and the lack of convenient, efficient light sources. Since that time, countless enthusiasts, both amateur and professional, have worked to solve the numerous technical problems involved in producing high quality photomicrographs. It is obvious from this book that the author, who is head of the photographic department of Beecham Research Laboratories Limited, is such an enthusiast. Not only is he an expert in photomicrographic techniques, and keenly interested in their practical applications in research work, but he also obviously derives considerable aesthetic pleasure from a well produced and presented photomicrograph, as all good photomicrographers should.

After a chapter on photomicrography, the author presents a comprehensive account of the construction of the microscope and its optics. This description is written from a very practical point of view for the microscope user, with many diagrams and only sufficient theory for an adequate understanding of the use of the instrument. Apparatus described and illustrated ranges from a simple set-up of bench microscope and box-camera, which any amateur could use, to the latest universal photomicrographic outfits. The next five chapters deal with all aspects of illumination including light sources, filters, adjustments for critical illumination and special techniques such as polarised light, phase contrast, and ultraviolet microscopy. Following further chapters on the more specialised fields of stereoscopic, flashlight and colour photomicrography, the author concludes with two practical chapters on photographic processing and the mounting and staining of specimens. A useful classified bibliography and a short, but adequate, index complete the book.

All the techniques described are illustrated by photomicrographs, some in colour. The captions to most of these illustrations include very full technical details of the microscope setting and photographic process used to produce them. This treatment makes them particularly useful to the photomicrographer who may wish to record similar subjects.

There was one disappointment for the reviewer. As a metallographer he was struck by the very scanty reference, both in the text and the illustrations, to the photomicrography of metals and alloys. Surely this field of work is at least as important and interesting as those covered by the author, and equally capable of providing interesting photomicrographs for illustrations. Similarly there are no examples from petrology, a branch of science in which the microscope is widely used. It is hoped that when the time comes for this book to be revised, the opportunity will be taken to repair these omissions.

The author intended to help scientists who wish to use photomicrography in their work, and photographers, both amateur and professional, who may be interested in the field. In the reviewer's opinion the author has succeeded in his aim, and anyone interested in the subject will find something of value in this book.

The publishers are to be congratulated on the excellent reproduction of the illustrations and on the high standard of the printing and layout of the whole book. This feature and the easy narrative style of the author make reading it a pleasure.

R. F. COTTON

Mixing in Turbulent Beds

Fluidization and Fluid-Particle Systems. By FREDERICK A. ZENZ and DONALD F. OTHMER. *Reinhold, New York; Chapman and Hall, London.* (120*s*)

When the flow of a gas or a liquid through a bed of solid particles supported by some porous device is gradually increased, a point is reached when the pressure drop across the bed is sufficient to support the weight of the particles. The bed of particles is then said to be incipiently fluidised. Any further increase in flow causes the bed to expand to accommodate the increase. The fluidised bed thus formed has many of the properties of a liquid; its upper surface remains horizontal when the containing apparatus is tilted, and it hardly impedes the movement of objects floated on the surface. When the flow of gas or liquid through the apparatus is increased still further, to the point where the flow velocity becomes greater than the free-falling velocity of the particles, then, clearly, the particles are carried out of the apparatus.

There is a marked difference in appearance between most gas-fluidised systems on the one hand and most liquid-fluidised systems on the other if the flow-rate of gas or liquid is increased above that required for incipient fluidisation. If a gas is used to fluidise the bed, the extra gas above that needed at incipient fluidisation largely passes through the bed in the form of bubbles; whereas with liquid-fluidised systems a reasonably uniform bed expansion is observed, the particles moving apart to allow for the higher liquid flow-rate. These two types of behaviour are known respectively as aggregative (or bubbling) fluidisation and particulate (or smooth) fluidisation. Although most gas-fluidised beds behave aggregatively and most liquid-fluidised beds fluidise in a particulate manner, there are exceptions to this pattern. For example, water bubbles are observed when lead shot is fluidised by water, and particulate fluidisation is found when very light resin particles are fluidised by high-pressure carbon dioxide. The parameters which appear to characterise the type of fluidisation are the density and size of the solid particles, and the density and viscosity of the fluidising medium.

A fluidised bed is an excellent way of bringing a gas into contact with a solid; the turbulent action of the bed provides, in particular, favourable conditions for mass and heat transfer. The first chapter of the book by Zenz and Othmer gives the best and most comprehensive account in book form of the many and varied ways in which the fluidisation technique has been used in industry. More than 50 applications are mentioned, complete with references to the literature.

Zenz and Othmer's book *Fluidization and Fluid-Particle Systems* follows so quickly upon Leva's book published in 1959 entitled *Fluidisation*, that some comparison between them seems necessary. Both books are long books, long enough to suggest that their authors are busy men—rather too busy to write short books!

Both books have accurate titles—Zenz and Othmer's book having a somewhat wider conception than Leva's. In Zenz and Othmer the fluidisation technique itself is treated (quite correctly) as only part of a wider collection of problems, and therefore it includes, for instance, chapters on the rheology of powders and the gravity flow of solid particles. Leva's book is more individualistic, more unified, and possibly a little easier to read than Zenz and Othmer's which, on the other hand, usually provides a greater amount of useful information. In both books data on fluidisation are perforce largely collated empirically; neither book in fact adds very much to the theoretical understanding of the subject as a whole.

The least satisfactory chapter in the book is the one concerned with "The bubble phenomenon in fluidised beds." It is clear that the authors have been somewhat at the mercy of the time it takes for a draft manuscript to reach the printed page, but this chapter seems to have suffered more than most for nothing is referred to after 1957. Thus the important contributions by Yasui and Johanson in 1958 and by Davidson *et al* in 1959 have not found place. It is stated (pp. 267 and 271), for instance, that the rate of rise of gas bubbles in a fluidised bed is "several times" the superficial gas velocity, which is certainly not true for all sizes of bubble. The authors also suggest an explanation of the nature of aggregative and particulate fluidisation in terms of the "relative compressibility" of the fluidising medium. This section is rather speculative in character and it seems doubtful whether it would stand treatment numerically. However, once the authors move away from the more theoretical to the practical the writing becomes both more interesting and convincing; there is, for instance, an informative section in this chapter on the use of baffling to break up bubbles in fluidised beds.

In a book of over 500 pages it is so easy for the reviewer to find some fault that recognition of the worth of the book as a whole may become obscured. This book supplies information on a very wide range of topics connected with fluid-particle systems, for example, on the physical characteristics of powders, pneumatic and hydraulic conveying, particle carry-over from fluidised beds, and the problems of heat and mass transfer. There is a useful chapter on the motion of single particles in fluids which is, in the end, the point at which theories of fluidisation must begin. It is also good to see that the recent use of tapered beds is mentioned. These beds are tapered sufficiently to maintain a constant superficial velocity for the fluidising gas as it passes up the bed. Using tapered beds it has been possible to reduce the turbulence found when gases are used to fluidise particles of high density (such as uranium oxide). The technique, however, is rather less successful with lower density materials like sand or alumina catalyst particles.

In a book of this type there seems to be room for a more adequate treatment of both distributor design and the scaling-up of fluidised bed equipment. These matters are of the greatest importance to the successful application of the fluidisation technique, and the views and experience of the authors in this field would be particularly interesting.

Zenz and Othmer's book is a well-produced account of fluidisation studies, and it has a good index. It will provide the chemical engineer in industry with much information, and give a spur to the theoretician to supply a sound background to the mass of experimental data. The high price of the book, however, will ensure that it will find its way more readily on to library shelves than into private ownership.

DAVID HARRISON

Science Makes Sense of Furnace Guesswork

Thermochemistry for Steelmaking. By JOHN F. ELLIOTT and MOLLY GLEISER. Volume 1. *Addison-Wesley Publishing Company, Reading, Massachusetts; Pergamon Press, London.* (75*s*)

It is interesting to note that iron and steelmaking processes involving the use of such well known plant as the blast furnace, the converter, and electric and open hearth furnaces were developed without the aid of any fundamental physico-chemical measurements. Indeed no such data were available at the time when Bessemer evolved his process for making steel and it is obvious that he possessed only a very hazy notion of what took place inside his converter. His early success was undoubtedly due to the fortuitous use of low phosphorus iron and it was left to other steelmakers to discover (with catastrophic results!) the inability of the Bessemer process to dephosphorise iron.

Fortunately for the industry, it was not long before Sydney Gilchrist Thomas introduced the basic steelmaking process, thus permitting the production of good quality steel from the readily available high-phosphorus irons. But here again, chemical aid was not available save perhaps for suggesting that the acidic oxides of phosphorus might react with basic oxides such as lime and magnesia and that such materials would be less likely to attack a basic lining than one composed of acidic oxides such as silica.

In spite of their empirical beginnings and the subsequent growth of process chemistry it is a remarkable fact that the acid and basic steelmaking techniques underwent only minor modifications until about ten years ago when a new cheap and abundant material was made available through engineering developments in the field of gas liquefaction. The material, tonnage oxygen, has had a revolutionary effect on the steel industry and today the open hearth furnace and Bessemer converter are being superseded by various pneumatic techniques employing pure oxygen as in the L/D, Rotor and Kaldo processes. Again, one cannot apportion any significant credit for this change to the discoveries of fundamental physico-chemical measurements.

In view of the negligible impact of physical chemistry on iron and steelmaking it is pertinent to consider why this is so. Undoubtedly, an important reason is that iron and steelmaking processes are highly developed arts in which the optimum procedures have been evolved by practical experience. The processes involve a bewildering number of variables such as temperatures, temperature gradients, surface areas, slag and metal compositions and concentration gradients, and when it is considered that a steelmaking slag contains at least six oxides, the complexity of the processes is apparent.

However, our understanding of the art has improved considerably from the large numbers of physico-chemical studies that have been undertaken during the last 25 years or so, but even today the work has largely been confined to thermodynamic studies of liquid metals and slags of relatively simple compositions, while the more difficult but practically important aspect of reaction rates has received negligible treatment. It is not difficult to understand therefore why the "theoretical" steelmaker lags behind his "artistic" counterpart and that such applications as have been made of chemical theory to practice have been in the nature of post-mortems!

The remedy is obvious: the laboratory studies must continue to amass data to reduce the gap between theory and practice and until this has been considerably narrowed or overcome, we must not expect physico-chemical studies to produce any spectacular "break throughs" in iron and steelmaking technology.

In the study of any subject there comes a time when it is necessary to take stock of the situation to assess what is known so that the knowledge may be applied and future work planned without duplication. Such an assessment has long been required and it is very fitting that the Massachusetts Institute of Technology, to whom we owe so much of our knowledge of the physical chemistry of iron and steelmaking, should have decided to undertake the gigantic task of collating and summarising the available data. The work, which was started four years ago, has had the continued support of the American Iron and Steel Institute and the present book is to be regarded as the foundation stone of the programme. A large amount of additional data have already been collected covering such subjects as the thermodynamics of slags, slag-metal equilibria, and kinetics of high temperature systems, and it will be published in future volumes as time and funds allow.

The book is a work of reference and while it contains occasional short passages of explanation, it is written essentially for the physical chemist who is familiar with thermodynamic properties such as enthalpy, entropy and free energy. Physical chemists in the non-ferrous fields should not be deterred by the title since there is information pertinent to their subjects.

The contents are divided into four sections and there is a useful index. Section 1 lists some of the physical properties of selected elements such as atomic weights, densities, melting, boiling and transition points, crystal structures, viscosities, surface tensions and thermal conductivities. Section 2 provides information on the thermochemical properties of selected elements. The latter are arranged in alphabetical order and such properties as heat capacities at constant pressures, enthalpy increments, absolute entropies, free energy functions, are given at 100° K intervals for each element in one or more states. In order to assist engineering calculations, the section ends with a set of graphs relating the enthalpy increments above 25° C (77° F) of the elements with temperature.

Section 3 lists the standard heats and free energies of formation of selected compounds grouped into carbides, nitrides, oxides, phosphides, silicides and sulphides. In order to avoid duplication, the authors have omitted data on the enthalpy and entropy increments and heat capacities since a bulletin on these is in the final stages of preparation and is to be published by Dr. K. K. Kelley of Pacific Experiment Station, US Bureau of Mines, Berkeley, California.

While the aim has been to present standard heats and free energies of formation at approximately 100° K intervals, it has not always been possible to do so owing to absence of experimental data. A considerable amount of data exists for carbides, oxides and sulphides. The nitride data show important gaps in our knowledge, for example, in the cobalt, copper manganese, nickel and niobium compounds, while the missing information on the phosphides and silicides is considerable. The standard free energies of formation for each group of compounds, such as carbides, are summarised as Ellingham diagrams, in which the standard free energies of formation are plotted against temperature. These diagrams enable the reader to assess at a glance the relative stabilities of, for example, the carbides at any particular temperature; if necessary he can then use the tabulated data to obtain accurate values.

Section 4 presents a large amount of data on the vapour pressures of selected elements and compounds and includes some useful notes on such phenomena as polymerisation, decomposition and disproportionation that complicate vapour pressure measurement. A table is given listing the heats of vaporisation of the elements,

and is followed by plots of the vapour pressures of the elements against temperature. Finally the vapour pressures of selected bromides, carbides, chlorides, fluorides, iodides, oxides and sulphides, are presented in tabular and graphical forms.

The book contains copious references which enable the reader to study the original work from which the data were obtained. Some thought has been given to the technician who may wish to work in f.p.s. units; the enthalpy increment and free energy of formation plots include Btu per lb mole as well as cal per gm mole scales and the temperature scales on all graphs include Celsius and Fahrenheit degrees.

There is no doubt that the book will be appreciated by a much wider circle than the physical chemists studying iron and steelmaking. The authors are to be congratulated on the way in which they have commenced an extremely exacting task and the excellence of this volume will undoubtedly produce an eager demand for the volumes to follow.

C. E. A. SHANAHAN

Welbourn on Webb

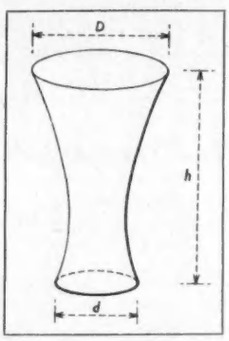
A Mathematical Tool-Kit for Engineers. By H. A. WEBB and D. G. ASHWELL. 2nd edition. *Longmans.* (15*s*)

The percipient person who reviewed the first edition of this book in these columns said "that every student of engineering should possess and study" it. I can only repeat this comment, and add a gloss. This new edition, again by Webb and Ashwell, contains four additional chapters on complex numbers, Macaulay methods, Laplace Transform, and theory of errors, together with an index.

To many generations of undergraduates reading engineering in Cambridge between the wars, mathematics and H. A. Webb were inseparable concepts. No one who attended them can have forgotten the lucidity and interest of his lectures, the humour with which they were lightened, and the "challenge questions" which he gave out at the end—usually stinkers.

Everyone has his favourite H. A. Webb stories; I shall quote two, unfortunately left out of his book, both of which concern the calculus of variations. He introduced the subject by telling how, at the end of the last century, golden syrup was brought on to the market, and a fierce price war developed. This was won by Tate and Lyle for the simple reason that one of the Tates (or was it Lyles?) had been a Wrangler in his day, and worked out that the optimum shape for the tin was for its height to equal its diameter. Since the tin cost more than the contents, Tate and Lyle captured the market! Later on (see Ex. 2, p. 48) he discussed the reason why all the tumblers in the LMS Railway dining cars were designed to spill the maximum possible amount of water. Their shape is shown in the illustration immediately below.

The reason for this extraordinary shape was that when inviting tenders for the glasses, the LMS had specified diameters for top and bottom, together with a height which would have given a half-pint glass if the sides had been straight. A clever man in a glass firm knew of the calculus of variations, and realised



that to this specification he could sell a lot less weight of glass if he made the tumblers to the shape shown; as a result, his firm got the order; and the LMS could not refuse tumblers correct to specification!

Webb's teaching, whether in lecture or supervision—and he was a great coach for the Tripos—was always earthy. A Smith's prizeman, he had worked with Bertram Hopkinson on aircraft problems during the First World War, and he was a true engineer at heart; several of the early R and Ms (Reports and Memoranda of the Aeronautical Research Board) bear his name, and they were good pieces of work, even though one on propeller noise was wrong. His attitude to engineers using mathematics was that of Heaviside—try any mathematical tool which seems right, and if the answer does not appear sensible, then probably the method was wrong.

As a supervisor he was superb. He once read a paper to a group of undergraduates entitled "The Supervisor's Tripos," the essence of which was that a supervisor deserved a third in the Tripos if he could, at 24 hours notice, solve any Mays or Tripos question which a student brought along; he deserved second class honours if, at 24 hours notice, he could solve any question by all the available methods; but he deserved a first only if he could pick up any problem in which a student had got stuck, and then, using the student's own tools, proceed to solve the distinction.

So any pupil could continue, recalling why the "Waratah" was lost without trace on her maiden voyage, or why. . . . Something of his breadth is illustrated by the fact that the senior fellow of my college, Nalder Williams, recalls how he, a classical scholar, and H. A. Webb came up to Trinity the same year; but it was H. A. Webb who collected the Greek New Testament prize. The fitting tribute to him is that which he paid to Fourier—"I take off my hat to him: twice."

D. B. WELBOURN

New Books

Hydraulische Abkantpresse HAP. By CURT F. KOLLBRUNNER and CESARE MASSA. *Verlag Leemann Zürich, Arbenzstrasse 20, Zurich 34.* (7 *SFrs*)

An interesting investigation into the design of a new type of hydraulic bending press.

Electronic Equipment Reliability. By G. W. A. DUMMER and N. GRIFFIN. *Pitman.* (45*s*)

The authors have considered the copious literature available on reliability, from the point of view of testing, statistical prediction, and design, and have produced a summary of present knowledge in the field.

Fortschritte der Destilliertechnik. Dechema-Monographien, Band 37. *Published for Deutsche Gesellschaft für Chemisches Apparatewesen, by Verlag Chemie, Weinheim/Bergstrasse.* (21·25 *DM*; members 17 *DM*)

This volume on progress in distillation engineering contains an account of three comprehensive experimental investigations on rectifying columns.

Hütte: des Ingenieurs Taschenbuch. Maschinenbau Teil B. 28th edition. *Wilhelm Ernst and Sohn, Hohenzollerndamm 169, Berlin-Wilmersdorf.* (48 *DM*)

Another volume in this valuable series of engineers' reference books, concerned with machine design and construction.

Basic Ultrasonics. By CYRUS GLICKSTEIN. *Rider, New York; Chapman and Hall, London.* (32*s*)

An introduction to the field of industrial ultrasonics, heavily illustrated in cartoon form. Applications dealt with include sonar, non-destructive testing, ultrasonic cleaning, drilling and welding, and instrumentation.

Trade Publications

Copies of any of the following trade publications are obtainable from the addresses given, though distribution is sometimes restricted.

Materials

Sprayed Metal Coatings. METALLISATION LTD., Barclays Bank Chambers, Dudley, Worcs. Aluminium coatings for iron and steel to DTD 906A and DTD 907B. Also nickel-chromium coatings. Introduction. 3 pp., ill.

Firebricks. MORGAN REFRACTORIES LTD., Neston, Wirral, Cheshire. Properties of 8 grades of firebrick made by an associate company, Douglas Firebrick Company. 2 pp, unill.

Translucent Sheeting. CASCELLOID LTD., Abbey Lane, Leicester. New grade of glass reinforced polyester sheeting called Cascalite Selfex has exhibited Ext. S.AA grading under BS 476 Pt. 3. New price list for all sizes. 2 pp, unill.

Filtration and Deaeration. HEAD, WRIGHTSON AND CO. LTD., 20 Buckingham Gate, London, SW1. Two leaflets. One covers deaeration equipment and the other filtration plant manufactured by the company under licence to Belco Industrial Equipment Division of New Jersey. Each 6 pp, ill.

Silicone Treated Papers. MIDLAND SILICONES LTD., 68 Knightsbridge, London, SW1. Few materials will adhere to paper treated with silicone resins. Introductory leaflet, 4 pp, ill; technical data sheet, 13 pp, unill.

Expanded Polystyrene Mouldings. EXPANDED PLASTICS LTD., Mitcham Road, Croydon, Surrey. How to convert granules of unexpanded polystyrene into lightweight mouldings at steam temperatures. 13 pp, ill.

Extended Surface Tube. TUBE INVESTMENTS LTD., The Adelphi, London, WC2. Describes wide variety of extended surface heat exchanger tubing made by companies in this group. Sizes and materials. What to ask for. 26 pp, ill.

Nitrile Rubber. BRITISH GEON LTD., Piccadilly, London, W1. Pictorial guide to processing and uses of Hycar nitrile rubber. 20 pp, ill.

The Reviewers

Mr. R. F. Cotton, B.Sc., is section leader in the Metallography Section at the research laboratory (Development and Research Department) of the Mond Nickel Company Limited. He is a member of the Iron and Steel Institute and the Institute of Metals.

Dr. David Harrison, A.R.I.C., is assistant lecturer in chemical engineering in the University of Cambridge, and fellow, tutor and praelector of Selwyn College.

Mr. C. E. A. Shanahan, B.Sc., F.R.I.C., F.I.M., is chief chemist and head of the chemistry department in the central research laboratories of Richard, Thomas and Baldwins Limited. He is the author of several papers concerned with the physical-chemistry of process metallurgy and with the analysis of metals.

Mr. D. B. Welbourn, who has long been one of ENGINEERING's regular contributors and book reviewers, had personal acquaintance with H. A. Webb, joint author of the present book, and is well qualified to recount the felicities—and idiosyncracies—of his teaching. He is a university lecturer in engineering at Cambridge, a fellow of Selwyn College, a former council member of the I.E.E. and a member of the I.Mech.E., with, in addition, considerable experience in industry.

Marketing

Finns Buy British Gear for Russian Ships

A FINNISH shipyard building two cable-ships for Russia has ordered all the cable handling equipment from a member firm of the BRITISH INSULATED CALLENDER'S CABLES group.

The company concerned, the TELEGRAPH CONSTRUCTION AND MAINTENANCE COMPANY (TELCON), began their experience in this field when fitting out the "Great Eastern" for the first successful Atlantic cable laying expedition, in 1866.

For the Finnish, WARTSILA-KONCERNEN, Sandvikens Skeppsdocka, at Helsinki, Telcon are to build (for each vessel) two forward picking-up and paying-out gears, draw-off and holding-back gears, dynamometers, bow gear and after-laying gear, and all ancillary equipment.

Each cable layer will be of 7,000 tons displacement, able to lay and repair submarine cables. One of the pair is due for delivery next year and the second in 1963.

Telcon are also supplying the electro-hydraulically driven portable picking-up and paying-out gear, of about 200 tons capacity and the largest of its kind, for laying the Magna flexible submarine gas pipeline, from mainland British Columbia to Vancouver Island. The contract for supplying this pipeline was recently awarded to BICC.

Rising Shipping Costs to United States and Canada

The shipping costs of exports from Britain to the United States and Canada were increased from the first day of this month.

Two major shipping conferences have decided on raising charges by about 10 per cent because of substantially greater cargo handling and ship operating costs. The shippers using the member lines of the NORTH ATLANTIC WESTBOUND FREIGHT ASSOCIATION have been advised of the new rates for traffic from the United Kingdom and Eire to United States east coast ports.

Similar steps have been taken by the CANADIAN NORTH ATLANTIC WESTBOUND FREIGHT CONFERENCE in relation to cargoes from the United Kingdom and Eire to Canadian Maritime, St. Lawrence River and Great Lakes ports.

Ghana Airways Buy Three BAC VC10s

The Ghana Government are to buy three VC 10 airliners from VICKERS-ARMSTRONGS (AIRCRAFT) Limited, part of the BRITISH AIRCRAFT CORPORATION.

The contract from Ghana brings the number of VC 10s on order to 48. The first of those for the BRITISH OVERSEAS AIRWAYS CORPORATION is on the production line. Test flying is due to start early next year.

Powered by four advanced ROLLS-ROYCE Conway jet engines, the VC 10 has the significant advantage of being able to operate with a full payload from high temperature or high altitude international airports.

GHANA AIRWAY'S VC 10s will carry up to 150 passengers, cruising at speeds up to 600 mph. The airline has announced that the three aircraft will be employed on routes between Ghana and Europe and to the Middle East and on additional routes to be developed.

Ghana Airways have also ordered three Viscounts and two Britannias from the British Aircraft Corporation.

Rising British Trade with Eastern States

The relatively small, but fast growing, part of the United Kingdom's trade which is conducted with the Soviet Union, China and their associate states, is shown by recent figures to have increased almost 300 per cent since 1950. British exports to the Eastern-bloc have risen almost four-fold in the last ten years—from £35 million in 1950 to £129 million in 1960.

Some of the items making up the 1960 total were copper exports to China (£8·8 million); machinery to the Soviet Union (£20 million); industrial machinery to Poland (£5 million).

The value of trade in both directions between Britain and the USSR, China, Poland, Eastern Germany, Czechoslovakia, Hungary, Rumania and Bulgaria, has risen as follows:

	£ million
1950	108
1951	146
1955	176
1956	200
1957	213
1958	224
1959	233
1960	293

Investment Capital in Norwegian Industry

The reply of the Norwegian Minister of Industrial Affairs, Mr. Kjell Holler, to a recent parliamentary question, indicates that before long Norway may appear among those countries better known for their efforts in attracting capital from overseas into industry.

Mr. Holler made it plain that investment would be wanted as well as foreign credit. He added that guarantees would have to be obtained that the results of these activities would be no less beneficial to Norway than if they were conducted by Norwegians. Those putting up the money will presumably be looking for assurances that their investment will be more profitable than if it had been made in their own country.

The greatest interest in investment from outside Norway has so far been shown in heavy industry, particularly in aluminium. Official policy favours control remaining in Norwegian hands, expecially in the development of hydro-electric schemes. A favourable eye is likely to be turned on those projects which may lead to fresh export earnings.

Lancashire Dynamo Licence for Emerson Electric

The entire Lancashire Dynamo range of electronic control equipment designed and developed over the last 15 years can be produced, subject to royalty payments, by the United States company, EMERSON ELECTRIC MANUFACTURING, of St. Louis, under an agreement reached with LANCASHIRE DYNAMO ELECTRONIC PRODUCTS, a subsidiary of the METAL INDUSTRIES group.

Machine tool control systems, process industry recorder/controller instruments, adjustable speed drives and other electronic applications for the engineering industries are among the Lancashire Dynamo products which Emerson Electric will now be entitled to manufacture in the United States.

£14½ Million Motorway Building Contracts

Contracts amounting to £14,614,969 for the construction of 26 miles of the Birmingham-Preston motorway between Warrington and Preston are to be accepted by the Lancashire County Council on the authorisation of the Minister of Transport.

The contracts, let to SIR ALFRED MCALPINE AND SONS and LEONARD FAIRCLOUGH Limited, cover the section beginning at the northern end of the Thelwall Viaduct (carrying the motorway over the Manchester Ship Canal and the Mersey and already being built), passing west of Wigan and Chorley and joining the southern end of the Preston by-pass at Bamber Bridge. Twenty-eight months have been allowed for the completion of the work, which means that the contractors have to face preparatory work during the rest of the present winter season, should get a good cut at major excavations during the coming summer, but will be left with finishing to do during the winter months of 1962-63.

Each of the motorway's two 36 ft three-lane carriageways will have a 10 ft hard shoulder. There will be a 15 ft wide central reserve. In addition to a railway bridge at North Ashton being built by the British Transport Commission there are to be 72 other bridges.

A separate contract covers a short length of motorway at North Ashton which will connect the Birmingham-Preston route with the A49 road near Wigan. Future extensions for the motorway, from just south of the Manchester Ship Canal, would run east of Crewe and west of Stoke-on-Trent and Stafford, turning south-east to pass east of Rugby and join up with the M1.

Identification Sought for Foreign Refrigerators

A request to the Board of Trade, that domestic and commercial refrigerator cabinets imported into Britain should carry an "indication of origin," has been referred to the Standing Committee (General Merchandise) appointed by the Board under the Merchandise Marks Act of 1926.

The detailed descriptions of the imported goods for which the indication —at the time of importation, sale and exposure for sale—has been sought are:

Domestic refrigerator cabinets, whether or not incorporating a refrigerating system or part of a system;

Commercial refrigerator cabinets, whether or not incorporating a refrigerating system or part of a system, including deep freeze cabinets, frozen food cabinets, service cabinets, ice cream conservators, display counters and farm freezers.

The Standing Committee is to hold a public inquiry. The Board of Trade states that "interests substantially affected" who wish to be heard at the inquiry should write to the secretary, Merchandise Marks Committee, Board of Trade, Room 1103, Horse Guards Avenue, London, SW1.

240 AEI Transformers for London Electricity

A total of 240 distribution transformers, each of 500 kVA capacity, have been ordered by the LONDON ELECTRICITY BOARD from ASSOCIATED ELECTRICAL INDUSTRIES.

The contract, worth more than £200,000, brings the number of 500 kVA transformers ordered by LEB from AEI in the past seven years up to almost 1,000, with an aggregate capacity of almost 500 MVA.

From the CENTRAL ELECTRICITY GENERATING BOARD, AEI have recently received an order which is part of a new scheme through which more power will be transmitted without adding to the number of overhead lines, by raising transmission voltages to 400 kV. The first line in the project is to be between Monk Fryston and High Marnham. It is intended to provide opportunities for operational experience. AEI are to supply high voltage tap changers for voltage regulation on the transformers at either end of the line.

The Wythenshawe, Manchester, works of the AEI TRANSFORMER division will manufacture the transformers for LEB and CEGB's tap changers.

Three Building Contracts for Medway Motorway

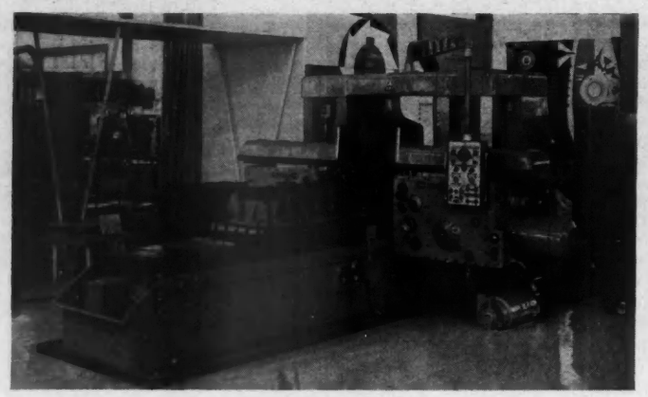
The Ministry of Transport intend to award three separate contracts for the construction of the 26 mile long Medway Motorway. The scheme is part of the comprehensive improvement of the A2 road from London to the Channel ports. On an essential part of the project, the £2·3 million Medway bridge, work is already going on; this bridge will have the longest prestressed concrete span in the world.

Announcing the invitation for tenders, Mr. Ernest Marples, the Minister of Transport, described the new motorway, to be known as M2, as leaving the London-Canterbury-Dover trunk road near Strood in Kent. It will form a by-pass to the south of Strood, Rochester, Chatham, Gillingham, Rainham, Newington, Sittingbourne and Faversham, rejoining the A2 near Brenley Corner.

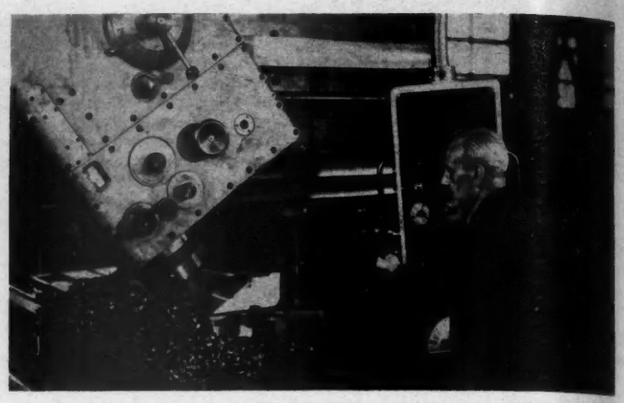
The first of the three contracts will cover the two miles west of the River Medway; the second and third will be each just under 12 miles and cover from the Medway to Stockbury and from Stockbury to Brenley Corner.

Parts of the road will be carried over the North Kent valleys on viaducts, one of which, across the Stockbury Valley, will be some 70 ft above the ground. Though normal motorway restrictions on the classes of traffic permitted to use the road will apply it is intended that separate facilities for pedestrians and cyclists shall be provided on the Medway Bridge.

Road building is expected to start early this summer and the road should be open to traffic in the spring of 1963.



FRM6—double-column milling machine with two horizontal headstocks and connecting bridge.



FRO8—single-column milling machine fitted with horizontal and vertical head stocks.

Milling Machines of Unit Construction

Standardised parts are used to build up the Czechoslovak FR range of milling machines. Remote and automatic control are provided.

A NEW range of milling machines is being produced at the TOS factory, Kuřim, Czechoslovakia. The machines are built up on the unit head principle from basic standard elements into single or multiple spindle, single or double column milling machines, or duplex horizontal plano-milling machines in various arrangements. Twelve of the basic forms are shown in the drawing and two of the models in the photographs above. The standard fixed or swivelling headstocks are made in three sizes, in universal or plain design.

The Series FR, as the machines are called, are suitable for milling work on large and small workpieces, both in one-off and batch production. Automatic operation from punched card is usual, although for more complicated work on multiple-spindle machines punched tape is used.

The aim has been to use the largest number of standard parts and groups. This means a wide range of machines available off the shelf, with production costs kept low. In addition, TOS consider that universal machines for small production or piece work require more and more automatic control, so that not only machining times but also down times can be kept as low as possible. Much of the interest in the use of unit heads at the TOS factory stems from the successful development of automatic production lines using similar heads.

Each machine can be operated by hand or by buttons on a suspended control panel. For automatic operation, a programme card with contact pins is bolted in a selector plate fastened to the panel. All the electrical control devices are located in a distributor console standing near the machine. For protection against overloads, a sensing device is incorporated that withdraws the tool from the cut when its loading exceeds a certain limit.

The main components of the Series FR are the table, column and auxiliary column, and the milling headstocks. Each of these main machine groups is available in a number of sizes and is fitted with independent mechanisms and drives. Table clamping surfaces vary from 0·5 m by 2 m to 1·6 m by 5·5 m.

The milling headstocks are independent units, normally supplied in a fixed pattern; a rotating version can be had on request. The spindle is mounted at three points. The front end rotates in a precision double-row roller bearing, the central part in precision ball bearings, and the rear end in the driving gear hub. In this way spindle deflection is practically eliminated, even when heavy cuts are taken. A flywheel mounted on the spindle provides a cushioning effect against torsion oscillations.

There are three sizes of headstocks: VF100 (weight 1,600 kg, 7·5 kW motor, 22 to 1,120 rpm), VF120 (2,200 kg, 14 kW motor, 28 to 710 or 22 to 560 rpm), and VF160 (3,400 kg, 28 kW motor, 18 to 560 or 22 to 710 rpm). The spindle is driven by the main drive motor through a gearbox, its speed being changed by a hand lever. The work feed of the headstock is derived from an independent Ward-Leonard set, the feed rate being continuously variable throughout its range.

WORKPIECES IN SERIES

Coarse adjustment of the spindle sleeve is carried out automatically under power, accurate adjustment is by inching, and fine adjustment into the cut is by hand. Automatic accurate adjustment of the tool to a preset dimension, by moving out the spindle sleeve against a positive stop, is carried out by power and initiated by a button on the control panel. The milling headstocks are brought to the required position under power at the lowest feeds, by means of a elsyn device.

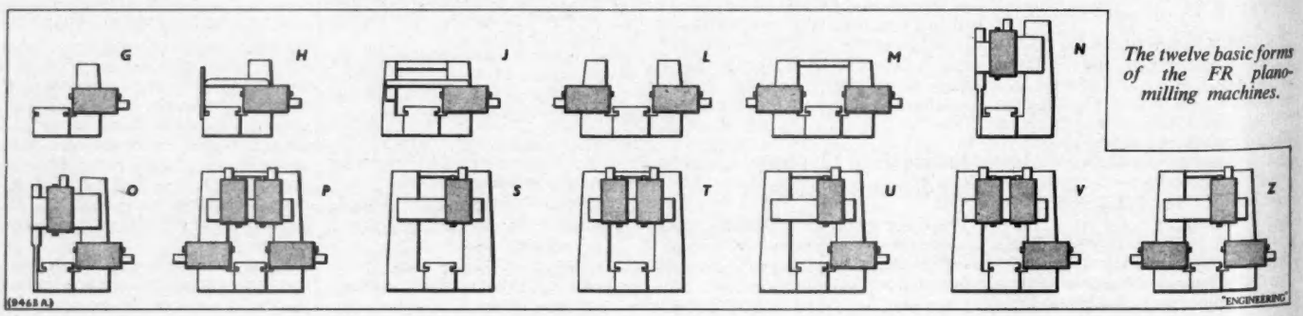
The table is provided with flat and V-guides. Its work feeds are derived from an independent Ward-Leonard set capable of a variation of speed of 50 to 1, controlled by buttons on the suspended panel. Rapid traverse of the table is carried out by an independent electric motor, in either direction, with the spindle running or at rest.

The ability of the table to move through automatic cycles can be used to advantage for the economical machining of workpieces in small series. The working cycle can be made up of rapid traverses and work feeds in both directions of table movement, with automatic reversing or stopping of the cycle. On machines such as the FRO 8, shown in the right hand photograph, where one side of the table is accessible along its whole length, clamped workpieces can be automatically milled at one end of the table while at the other end the setting up and clamping of the next workpiece can be in progress. This is of considerable value in series production.

Facilities for climb milling are incorporated, a patented design being employed to eliminate backlash between the threads of the driving screw and the rack of the table. During rapid traverse of the table, the climb milling equipment is automatically disengaged. In multiple production, the climb milling equipment enables the continuous reciprocal movement of a cylindrical cutter to machine workpieces in two clamping fixtures. In one clamping fixture the workpiece is machined by the conventional milling method; in the other it is machined by the same cutter by the climb milling method.

The column is made rigid by the use of heavy longitudinal and transverse ribs. Further stiffening is provided in double-column machines by the connecting bridge. On the bottom of the column are bolted the driving and distributing boxes for the feeds of the milling headstocks. The distributing box contains an arrangement for the automatic withdrawal of the milling head at the rapid return of the table. On the rear of the column are situated a tank and pumps for the hydraulic clamping of the milling headstocks to the column.

The bed ways and the motion screw box are lubricated automatically with oil under pressure from a pump and tank inside the bed. All gearboxes are lubricated automatically by independent pumps.

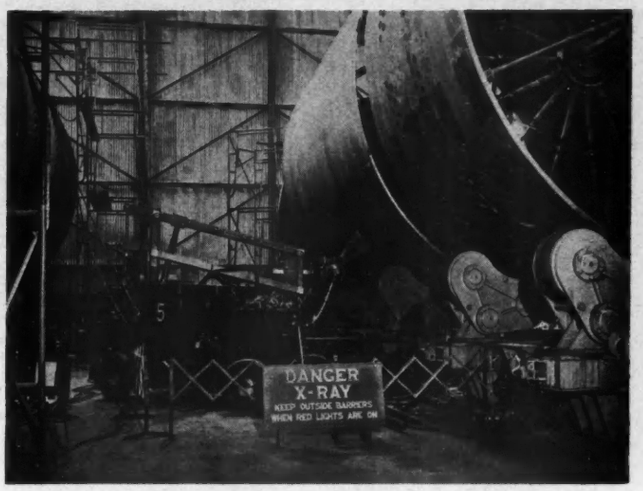


The twelve basic forms of the FR plano-milling machines.

X-Ray Welding Inspection

Rated at a peak voltage of 400 kV, five Pantak X-ray units used to check the welds of the reactor vessels at Hunterston are the largest constant potential units currently produced in the United Kingdom. At this power station, where work is now well advanced by the GEC-Simon Carves Group, the Motherwell Bridge and Engineering Company are responsible for the fabrication of the reactor vessels and steam raising units. They are using five 400 kV Pantak X-ray units and three of 220 kV capacity.

The larger machines use a constant potential or double Greinacker circuit which leaves only a small ripple on the rectified output current. This circuit enables the maximum penetration power to be obtained for the current used. Exposure time at Hunterston for a 3 in thick weld is 7 minutes, using a 400 kV set in conjunction with Kodak D film and lead screens. This relatively short exposure time enables a high degree of sensitivity to be achieved. Of particular note in the operation of these machines is the great operator safety which is afforded by extensive lead shielding within the tube, a feature which enables other routine work to be carried out reasonably near to the operating area.



Pressure vessel testing using a Pantak 400 kV mobile X-ray unit. Exposure time for a 3 in thick weld is 7 minutes.

Although 250 kV machines could be used for this job the exposure time would be 20 minutes—a disadvantage which would lead to a lack of definition due to scatter radiation. This problem becomes accentuated as plate thickness increases, and as pressure vessel fabrication moves steadily into the field of 4 in thick material and above, increasing interest is being shown in such particle accelerators as the betatron to provide a high energy source of X-rays which will allow high speed, hot state radiography to be undertaken with the minimum of scatter.

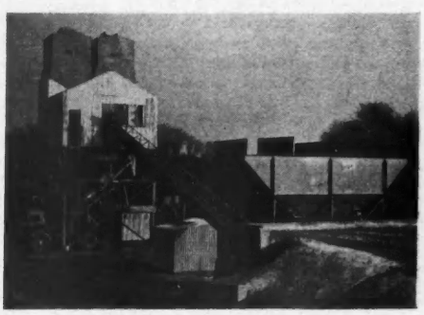
Ready-Mixed Concrete for Industry and Agriculture

Emphasising the increasing popularity of ready-mixed concrete, a new wet/dry plant has come into service at Chilmington, near Ashford in Kent. It is a Blaw-Knox Batchmaster installation and it belongs to Nickolls Ready-Mixed Concrete Limited. This is the first service of this kind to be operated in this part of Kent where industry flourishes alongside farming.

The plant incorporates the new Blaw-Knox Gyramixer 1 cu. yd pan-type concrete mixer which has a rated output of 60 cu. yd of mixed concrete per hour to any specification ranging from pavement quality to harsh lean mixes. The Batchmaster low level batcher has storage for 30 cu. yd of aggregates in four compartments and is loaded from stockpiles by a heavy duty wheeled tractor shovel. The aggregate weigher is of 42 cu. ft capacity and weighing accuracy is assured by a patented hydraulic system. Feed gates and weigh hopper discharge gates are electro-pneumatically operated by remote control from the main control panel located by the mixer on the high mounted structure. The weigher discharges dry aggregates on to a troughed belt conveyor which conveys them to the Gyramixer.

Twin bulk cement silos of 30 tons capacity provide storage for two types of cement, normal and rapid hardening, which is independently weighed in an 800 lb weigher and discharged directly into the mixer. Cement capacity can be increased by banking up additional silos and coupling up the fluidising conveyors.

The Gyramixer is high mounted enabling it to discharge directly into agitators and truckmixers of all types and capacities, or into tipping vehicles or site trucks through a new type of swivelling telescopic discharge chute. The cement silos are also raised to permit the weigher to discharge cement directly into the mixer pan thereby obviating prior contamination of the cement by surface-moist agg egates.



The new ready-mixed concrete plant.

Reclaiming Worn Parts

A part of the service operated by Levertons of Spalding, main dealers for the Caterpillar Tractor Company, is the reclamation of tracks, grouser shoes, rollers, idlers and sprockets. These items all wear to a degree which varies with the type of duty being performed and the amount of attention given to these parts during service.

Thus, for example, much of the wear which occurs on the driving sprocket is found on the tooth surfaces which engage with the track bushings, and attention towards the alignment and correct tension of the tracks by a few adjustments or change in operating practice can add considerably to sprocket life.

An effective method of reclaiming worn sprockets for D2, D4, D6, D7, D8 and D9 tractors entails cutting off the entire rim and welding a new rim on to the spokes. The practice requires accurate cutting and positioning and a careful welding sequence to ensure the minimum of distortion. Since the entire torque output of the tractor is transmitted through these spokes, high-quality welds are required.

In practice, the worn sprocket is clamped into a flat jig which carries a centring plate and adjustable radial arm with a guide at the far end to receive the tip of the cutting torch. Each spoke is then cut and a 30° tip guide is used with the arm to give the correct amount of matching chamfer. After the slag has been removed from the spokes, and the weld lugs of the new sprocket rim have been cleaned, they are set up on a sprocket stand and checked for squareness, central location and concentricity. When this has been completed, the first tack welds are made using 8 gauge Cooper and Turner Opal electrodes to get good penetration. The root runs as all following runs, are made using 6 gauge electrodes of the same type. Completed welds are peened to reduce welding stress while they are still hot.

In selecting a suitable electrode for this duty, an extensive series of tests was carried out. Particular care was directed to ensuring the maximum welding efficiency, a feature which is reflected in the fact that although over 4,000 sprockets have been reclaimed by this method, no case of weld failure has yet been reported.

Welding a new rim on to the spokes of a tractor-driving sprocket.

New Tower of London for Microwave Links

Television and trunk telephone services are going to depend more and more on microwave radio links in the future, according to a statement made by the Postmaster General, Mr. Bevins, in the House of Commons last week.

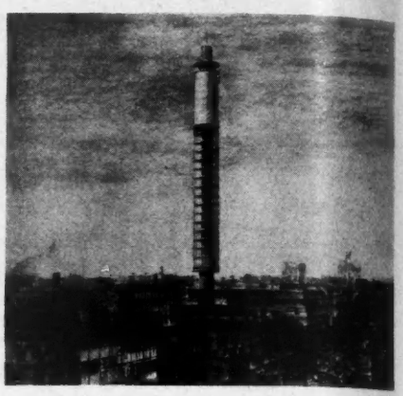
Since these links require a clear line of sight from point to point, the problem of keeping a suitable link centre open in the middle of London is becoming increasingly difficult. Many new high buildings have been, and are being, built, which would block the path of microwave signals going to and from the present radio mast at the Museum exchange, which has an effective height of only 180 ft.

To overcome this problem, the Post Office plans to build a 507 ft tower at the present exchange in Howland Street, W1, which currently handles the interconnection of radio and television networks of the BBC and ITA as well as being the London focal point of microwave radio links for trunk telephone traffic.

The new tower will not be used to broadcast television programmes direct to the public. Its job will be to relay programmes between the studios, control centres and transmitters of the broadcasting authorities. It will also act as a convenient centre for outside-broadcast hook-ups in the Greater London area and will be a suitable focal point to meet anticipated future demands for closed circuit facilities for industrial and commercial purposes.

There will be room for expansion to meet all the foreseeable needs for radio links during the next 40 years. For example, it is expected that by 1980 there will be 24 telephone systems in use, each capable of carrying 960 separate telephone conversations. This number could be doubled in the following 20 years and still leave room for over 100 television outlets, capable of serving, among other things, a colour television service.

The design of the tower has not been based on purely functional requirements. In fact it is hoped that it will become a landmark and amenity for Londoners and tourists. A public observation platform is to be provided at a height of 460 ft and will be served by high-speed lifts travelling at a rate of 8 mph. The tower should be completed by mid-1964.



The proposed 500 ft GPO tower is intended to become London's centre for all television and telephone microwave links. It is intended to meet expansion in radio links during the next 40 years

Photographic Technique for Cosmic Ray Research

A new type of electronic tube, sensitive enough to expose individual particles of light, has recently enabled research workers to photograph the faint tracks of cosmic rays as they move through a solid crystal at a speed near to the velocity of light.

The high-energy-particle camera which was used for the photography in these experiments was developed at the laboratories of the Westinghouse Electric Corporation in Pittsburgh, USA.

This device has been described as one of the newest tools of the nuclear physicist. Though cosmic rays, or other high-energy particles remain within the crystal for only about 10^{-9} second, they leave luminous tracks which reveal their identity and behaviour. These tracks, however, are much too dim to be seen or photographed without some means of greatly increasing their brightness.

In the Westinghouse experiments, the brightening is accomplished by a newly developed light-amplifying tube called the Astracon. The tube is based upon a thin-film system which, though invented several years ago, was only recently brought into practical use. Development of the Astracon was supported in part by the United States Atomic Energy Commission and the United States Army Engineer Corps.

Incoming particles of light (photons) are admitted into the Astracon which then uses them to release electrons from a light-sensitive input surface. The emitted electrons are accelerated and guided successively on to a series of thin films. At each film, an incident electron ejects five or six additional electrons, which move on to the next film. After being multiplied in this way through several stages, the electrons strike a phosphor screen similar to that in the viewing end of a television cathode ray tube. Here they re-emit about 10,000 photons of light (in a four-stage tube) for each photon that originally entered the tube. As a result, invisible images on the tube's input surface are increased in brightness at the output by as much as several thousand times.

"These experiments demonstrate the feasibility of using the Astracon in high-energy particle research," said Mr. A. Anderson, manager of Westinghouse's applied physics department. "The degree of light amplification which the Astracon provides should make the scintillation crystal an increasingly effective tool for modern physics, where it will supplement the more familiar cloud chamber and bubble chamber, now being used in cosmic ray research."

In recent Westinghouse experiments, the light that was generated along the path of a cosmic ray moving through a crystal was focused by a mirror system on to the input surface of an Astracon tube. The image produced by the tube was then passed through a lens system which focused it on to the input surface of a second Astracon tube. This second tube was triggered to operate only when a desired flash of light occurred in the crystal. Thus it acted as a shutter that could be opened or closed in a small fraction of a second, and as an amplifier of light during the time that it was operating. The final image produced on the second Astracon tube was then directed on to a photographic film, which recorded the path of the particle.

A major advantage with this new technique is the unusual simplicity and compactness of the required equipment. Each Astracon image tube is about 4 in in diameter and 6 in long. The entire assembly—scintillation crystal, Astracons and their focusing magnets, coupling lens systems and camera—is little more than 3 ft in length.

Another advantage is the very low "dark current" inherent in the Astracon. Dark current is that which normally flows in an imaging device when not receiving the desired light impulses. It shows up as spurious flashes and background illumination, thus interfering with the desired image. The dark current characteristics of the Astracon are said to be more than adequate for nuclear track photography and other low light-level applications.

The Astracon has already been used experimentally in astronomy for increasing the brightness of the images and spectra of distant stars. An additional application that is forecast for the device is the brightening of X-ray images, thereby shortening the exposure time and reducing the dosage to the patient.

High-Resolution Storage Tube

A low voltage storage tube, capable of storing high-resolution half-tone information, has been developed by Mullard Limited, Torrington Place, London, WC1. Known as the Tenicon, it has a single gun and uses magnetic focusing and deflection.

The operation of the Tenicon is simplified by the fact that it has been designed to operate with the circuitry of the standard Vidicon camera chain and may be plugged-in in place of the Vidicon tube.

The electron gun is similar to that of the Vidicon, having a fine mesh spaced a few millimetres from the target and parallel to it. The target is a continuous layer of insulating material, and the side remote from the electron gun has a metal coating which is connected to the signal electrode.

Before writing, the target surface is stabilised at the cathode potential, which is defined as zero. Writing is accomplished by first switching the cathode potential to about -100 volts. The final anode and grid potential are simultaneously switched to retain the beam focus at the target during the writing process, at the same time keeping the beam cut off until the moment when writing begins.

Information to be stored is applied as a positive signal to the grid, so modulating the beam as it scans the target surface. The primary electron energy is such that the secondary emission coefficient of the target is greater than unity and, hence, the potential of each element of the target shifts positively by an amount which is determined by the instantaneous beam current, the scanning speed, the secondary emission coefficient and the target capacity.

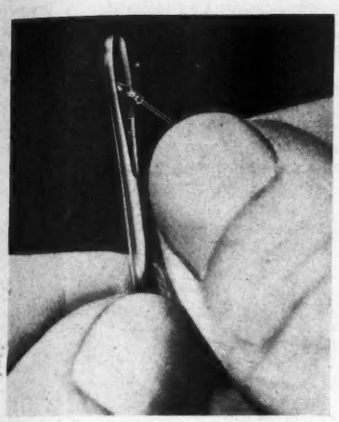
The read-out process is identical with that of the Vidicon. The cathode potential is restored to zero and the grid and final anodes are restored to the values required to produce a well focused beam at the target. The unmodulated beam is scanned over the target surface, landing with an energy of only a few volts, at which secondary emission is negligible. All the elements which had been shifted in potential during writing are thus discharged, restoring them to zero volts and producing a capacitive signal current in the target lead.

Providing sufficient beam current is used in the reading scan, the discharge will be almost complete, leaving the target ready for another signal to be written. The residual signal after readout is less than 20 per cent, and the tube may therefore be used in television applications requiring sequential storing and reading out of pictures without an objectionable lag.

Microminiature Tungsten Filament Lamp

A microminiature incandescent lamp, measuring only 0·055 by 0·175 in, has been developed by the Special Products Division of Thorn Electrical Industries, Thorn House, Upper St. Martin's Lane, London, WC2.

This new device will provide specialists in the field of microminiaturisation with a compatible light source which may be used for a wide variety of applications, such as photoelectric logic systems, medical equipment, high-speed punched card and tape readout equipment, compact matrix displays and airborne electronic equipment.



Small enough to go through the eye of a sack needle, this new tungsten filament lamp has a light output of up to 50 millilumens.

The filament is made from tungsten wire 25×10^{-4} in diameter, wound in a coil of 40 turns. The lamp is designed to operate between 1·0 and 1·5 volts, with a design centre rating of 1·3 volts. The cold resistance is 6·5 ohms minimum and the hot resistance 38 ohms minimum, at a current of 35 mA. At 1·3 volts, the maximum lamp current is 30 mA, which permits direct operation from a transistor. Operating at its design rating, the life expectancy is said to be 2,000 hours.

Despite its size, the Mite-t-Lite, as it is called, is remarkably efficient. The light output is 45 to 50 millilumens at 1·5 volts, which is sufficiently strong to be seen in normal room lighting.

Because of the low thermal inertia of its filament, this new lamp has a significant modulation capability. Light output will follow voltage impulses up to 100 per second.

New Process for Steel Protection

Prevention of corrosion, due to various aggressive actions, has always been a major problem in the manufacture and utilisation of steel. This question has for many years engaged the attention of research workers throughout the world and a wide variety of patented processes has ensued. However, it would appear that none of these has, as yet, yielded permanent results.

In a recent issue of *Hungarian Foreign Trade*, a process known as "Kenderisation," named after its Hungarian inventor, T. Kenderi, was described as being a significant step forward in this field.

It is said that Kenderised steel is malleable and can be bent and welded without injuring the protective layer. Even the welding seams become resistant to corrosion.

Semi-finished goods, sheets, shapes, pipes, etc., can be Kenderised in the mill, they will not corrode during storage or machining, and they retain their anticorrosive properties during utilisation. Paint is said to adhere far better to Kenderised steel due to its surface properties.

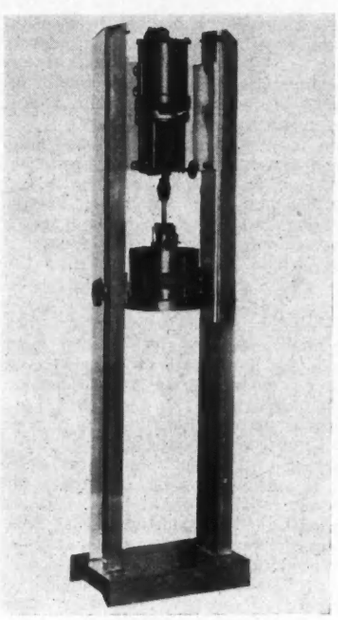
Licencia, the Hungarian company which deals with the sale and licensing of Hungarian inventions, is said to have been approached by several British, American and West German firms for the licence of the Kenderising process.

Permeation Cell for Laboratory Studies

A laboratory-scale membrane permeation cell which incorporates recent developments in selectively permeable membranes and can be used to change the composition and separate the components of fluid mixtures, has been developed by Ionics Incorporated, Massachusetts, USA.

Membrane permeation is a technique which utilises membranes to permit easier passage of one or more components of a mixture in relation to the remaining component. Appropriate selection of membranes and operating conditions (such as temperature and pressure) make possible the effective separation of various components in industrial process streams.

Typical of the many applications which lend themselves to membrane permeation techniques are the breaking of azeotropes, separation of close boiling mixtures, removal of water from organic compositions and driving equilibrium mixtures to completion. According to Ionics Incorporated, the new permeation cell makes possible complete process research investigations of promising commercial applications, including economic evaluations, determination of process variables, and membrane selection and development programmes which may lead to the optimising of pilot plant designs and full-scale processing cost estimations.



Using selectively permeable membranes, this permeation cell has been designed for advance evaluation studies.

The cell has a nominal volume of 55 litres and an effective membrane area of 23·8 sq. in. The standard rated working pressure is 150 lb per sq. in at 325° F. Higher pressure ratings can easily be obtained.

The cell is equipped with a heating mantle, pressure gauge and thermometer well, and may be operated on a batch or continuous basis. An internal chamber provides a means for rapid cooling. If desired, the chamber may also be used as an alternative heating or temperature control system.

Improved Efficiency for Thermal Electricity

An experiment in which a thermionic converter and a thermoelectric generator were combined, is said to have produced a factor-of-two improvement over present-day apparatus for converting heat directly to electricity.

Engineers of the US General Electric Company, who reported the experiments, pointed out that, since thermionic conversion is more efficient at higher temperatures while a thermoelectric generator works best at lower temperatures, a combination device in which the thermoelectric generator uses waste heat rejected by the converter is likely to be much more efficient.

In the experiments, a commercially-produced vacuum thermionic converter (Z5386) was operated at a cathode temperature of 875° C—well below its normal operating point. At this heat level, the converter produced 0·2 watt. At the same time, a zinc antimonide thermoelectric generator, connected to the anode side of the thermionic converter and using its rejected heat, produced 0·34 watt at a hot junction temperature of 350° C and a heat sink temperature of 100° C.

At the 1,150° C cathode temperature for which it was designed, the Z5386 converter produces a minimum of one watt at 2·5 per cent efficiency. According to General Electric's engineers, if the waste heat from a Z5386 operated at this temperature were used to power a lead telluride thermoelectric generator, the system's power output would be about 2 watts at 5 to 6 per cent efficiency.

Moreover, studies indicate that efficiencies of 16 per cent of more may be attained by using a vapour thermionic converter at a cathode temperature of 1,325° C cascaded with a lead telluride thermoelectric generator at a hot side temperature of 650° C and a cool side temperature of 75° C. Such temperatures are possible with solar, nuclear or chemical energy as the heat source, and with water as the coolant.

Radio Telescopes in the Ionosphere

A Blue Scout rocket, launched from Cape Canaveral on 7 January, has been used to lift a radio telescope above the earth's opaque ionospheric atmosphere.

According to a report issued by Professor D. H. Menzel, director of the Harvard College Observatory, four small radio telescopes successfully broadcast back to earth, measurements of low frequency cosmic radio noise. The passage of such low frequency cosmic noise cannot reach ordinary terrestrial radio receivers due to the absorption properties of the ionosphere.

Detailed studies with space radio telescopes will permit astronomers to gather new information about cosmic radiations that originated thousands of light years away. Information will also become available about the weak magnetic fields in interstellar space, the proton and electron clouds between the sun and the earth, and the radio noise storms on Jupiter.

Professor E. Lilley, who heads the Harvard space radio telescope project, said that a preliminary study has indicated that all four radio telescopes worked according to plan throughout the ultra-ionospheric flight of the rocket.

Each radio telescope was composed of a transistorised receiver, the size of a pocket radio, and a collapsed aerial which was able to extend on command to a length of 10 ft.

The same radio telescopes were also used to conduct a new measurement of the earth's ionosphere. A separate Harvard research team, centred off the coast at San Salvador Island, sent high-powered coded radio pulses toward the ionosphere during the rocket's flight. Most low frequency radiation is reflected back to the earth by the ionosphere. However, it has been suspected for some time that the ionospheric shell may have small "holes," through which a small fraction of the terrestrial radio energy could leak.

Do Pressure Vessel Codes Need Unifying?

An important step towards economy in the pressure vessel industry would be a unified code acceptable to all the British authorities concerned.

CONTINUED growth of the chemical, petrochemical and petroleum industries in the last two decades has brought with it an increased demand for pressure vessels. Add to this the advent of the nuclear reactor containing within its walls the fearsome energy to which man is not as yet altogether accustomed, and it can be seen that the designer of the post-war pressure vessel has been compelled to advance at quite a rate, and often somewhat in the dark.

Working pressures have risen, with consequent increases in shell thicknesses. Take, for instance, the UKAEA's reactor vessels at Calder Hall and those to be built at Dungeness. At Calder Hall, the working pressures are 100 but at Dungeness 268 lb per sq. in, and the relative vessel thicknesses 2 in and 4 in. Fig. 1 shows the top dome of the reactor pressure vessel at Windscale.

It could be that the time has come to revise and rationalise the codes and material specifications to which designers throughout the world work. It is a familiar cry that British products are made too good and because of this we can suffer in a competitive market. This argument was lent some weight in a paper by J. F. Lancaster which made a comparison of US, European and Commonwealth pressure vessel codes. This paper was one presented at a recent symposium held at the Institution of Mechanical Engineers under the general title "Pressure Vessel Research towards Better Design".

The object of Lancaster's paper was to review and compare the laws, regulations and codes governing the construction of welded boilers and pressure vessels in the countries stated above and in so doing to give an appraisal of the possible future lines of development of British boiler and pressure vessel codes.

LEGAL CONTROL

There is a wide variation in the degree of legal authority given to construction codes and the degree of governmental inspection of boiler and pressure vessel manufacture in the countries examined, ranging from virtually no control, as in the UK, to the very close official supervision of the content of the code and of all phases of construction which is achieved in many European countries. Experience suggests, however, that standards of safety achieved in these various countries are uniformly high; failures of welded pressure vessels are rare and when they occur are not normally associated with inadequate wall thickness or deviations from the normal standard of construction. In fact, this desirable situation results more from a combination of sound engineering practice with commercial integrity than from any form of legal compulsion.

Estimates of the elevated temperature properties of steels given in specifications or implied in the permissible design stresses listed in the codes, vary quite considerably. In general, continental European codes tend to be more conservative than the ASME code in the design stresses permitted for carbon steel in the creep range; in particular the German figures for carbon steel at temperatures over 650° F (which are backed by a substantial research effort) are decidedly lower than the American figures, although results for comparable alloy steels are similar. This discrepancy gives rise to some uncertainty when, for example, a vessel to be used at elevated temperature is designed to the ASME code using German steel, and it emphasises the need for the further extension of knowledge of the creep properties of standard carbon steels.

DESIGN

Fig. 2 (simplified) shows the wall thickness of welded cylindrical, carbon-steel shells as a function of internal pressure. These curves have been constructed using the maximum joint efficiency factor permitted by the code in question, in combination with the basic design stress for the steel. The wide variation between the wall thicknesses so derived springs mainly from the variation of the basic permissible design stress. This is further illustrated in Fig. 3 which shows the variation of permissible stress with temperature according to six of the codes. From Fig. 2, it is plain that the German code allows for a pressure vessel of getting on for half the thickness of one made to a British code for the same pressure.

The most immediately obvious division is between those countries which permit a design stress equal to two-thirds of the yield or proof stress (Holland, Germany, and the Scandinavian countries) and those which limit the design stress to one-quarter of the ultimate tensile stress (Britain, the Commonwealth, France and the United States). Use of the former criterion leads to considerable economy in the use of material for carbon-steel pressure shells as compared with the older system current in Britain and the US. Such economies are even more pronounced when high-yield-point steels are employed.

One of the essential functions of a pressure vessel construction code is to give safety in use. However, it may be questioned how far the existence of a detailed code is essential to this end. Another function of a code is standardisation. The industry manufacturing and using boilers and pressure vessels is a large one with wide ramifications, and it is self-evidently essential to have some degree of standardisation in the manufacture of its apparatus. Standardisation can reduce costs at all levels; at the design level by simplifying design procedures; at the supply level by standardisation of the size and design of nozzles, manways, vessel ends and so forth, and in construction by minimising the need for independent detailed decisions by inspectors and by rationalising the procedure for accepting vessels.

So far as Great Britain is concerned, the chief obstacle at present to effective standardisation is the existence of three main codes applicable to boilers and pressure vessels, namely, the British Standard Codes which include BS 1113, and BS 1500, Lloyd's Rules, and the AOTC Rules. The existence of these different codes in turn generates a mutiplicity of material specifications, results in different standards being set for vessels having similar duties, adds to the amount of drawing office work, reduces the possibility of standardisation in construction, and adds considerably to the burden of inspection. It would be an important step towards economy in the industry concerned if a unified code acceptable to all authorities concerned could be developed in Britain.

Perhaps the most controversial issues concerning the development of pressure vessel design in Britain are, first, whether it is justifiable to increase the allowable design stress and, secondly, whether the basis for assessing the allowable

Fig. 1 Top dome of a reactor pressure vessel.

stress at normal temperature should remain the ultimate tensile strength of the material or its yield strength. The current trend in continental Europe is towards an acceptance of the yield stress (or proof stress) divided by a factor of 1·5 as the permissible working stress in a vessel shell. In Germany such a method of calculation has been used, with official approval, for some 20 years, and there has been no evidence of unsafety of operation of vessels so designed due to inadequate wall thickness. The use of the yield or proof stress as the basis for design stress is attractive because it is a step towards making the design process more rational. It is also attractive because (assuming that a safety factor of 2/3 is used) the weight and cost of a vessel for any given duty is reduced.

The establishment of a single boiler and pressure vessel code with a single administrative body would be a most desirable step towards standardisation and economy in the industry which manufacturers and uses boilers and pressure vessels in Britain, and any development towards increased permissible stresses should be secondary to the unification and strengthening of existing codes.

Fig. 2 Wall thickness of welded cylindrical carbon-steel shells as a function of internal pressure.

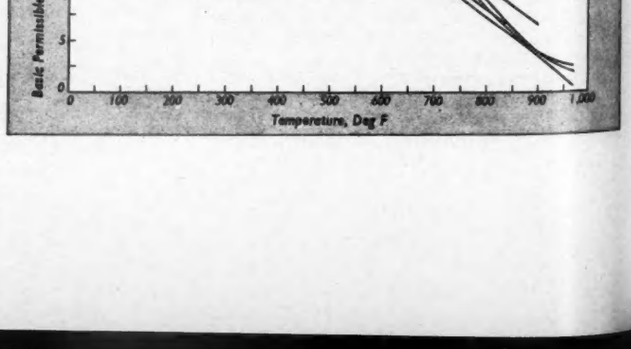

Germany H II
Sweden 1430
Holland QMC 41
France A42 C3 S
U.K. BS 1501-151 GR B
U.S.A. ASHE A285 GR.C
Basic Permissible Stress, Thousand Lb per Sq In
Temperature, Deg F

Fig. 3 Permissible stress as a function of temperature.

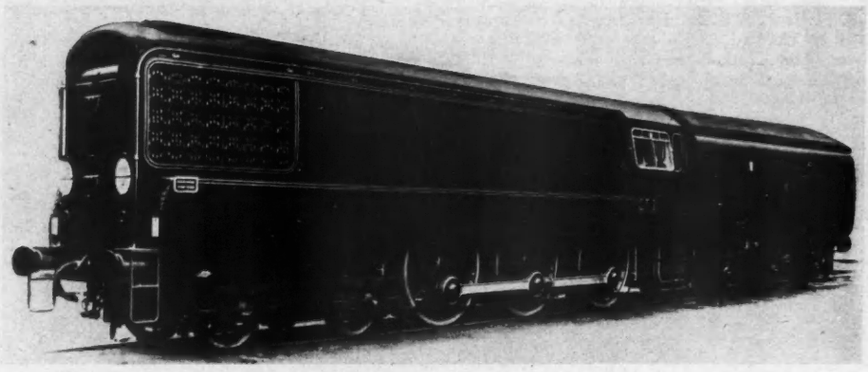
Gas-Turbine Locomotive Starts Trials on British Railways

An experimental gas-turbine locomotive—which in its appearance is not unlike a conventional steam locomotive—has been completed by the English Electric Company Limited at the Vulcan Foundry, Newton-le-Willows, and has recently started its trials on the London Midland Region of British Railways. It is designated GT3.

Expected to enter revenue earning service later in the year, the prototype is the product of successful bench and track tests at the BTC test station at Rugby. The unit consists of locomotive and tender, with a 4-6-0 wheel arrangement and a driving wheel diameter of 5 ft 9 in.

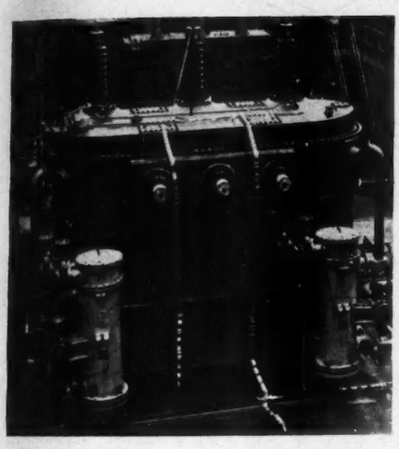
Power is provided by an English Electric 2,700 hp EM 27 L gas-turbine, which has been specially developed for direct mechanical drive, with a separate power turbine. It was built at the company's Whetstone works. A simple reverse and reduction gearbox is employed.

With a full tender, containing 2,000 gallons of gas-oil fuel, 1,750 gallons of water and the train heating equipment (a total of load over 15 tons), the complete locomotive weighs 123 tons and the overall length is 68 ft.



The English Electric unit is the third gas-turbine locomotive to run on the home railways. Previous experience has suggested that British Railways derive little or no benefit from gas-turbine traction because for much of the time locomotives work at only a fraction of full power, when thermal efficiency is low. Perhaps the English Electric design is the answer to this difficulty.

British Transformers for Niagara Power Project



Thirteen Ferranti transformers, rated at 180 MVA each, will serve the Niagara Power Project.

Thirteen Francis-type water turbines, each rated at 200,000 hp, will be directly connected to 13 generators, each rated at 167 MVA, at the Lewiston Power Plant for the Niagara Power Project in the United States. Each of these generators has an associated transformer rated at 180 MVA (six at 13·2/120 kV and seven 13·2/240 kV at 3 phase, 60 c/s), and they will be supplied by Ferranti Limited of Hollinwood, Lancashire.

Seven transformers will be used to supply the 120 kV section of the switchyard and six to supply the 240 kV section. Connection between any generator and its respective transformer will be by isolated phase bus, while the connection between the high-voltage terminal of any transformer and its respective bay in the switchyard will be made by high-pressure oil-pipe type cable, 120 or 240 kV as required.

Windings have graded insulation for operation on a solidly grounded system and incorporate directed oil flow. The transformers are of the forced-oil, forced water-cooled, inert gas-filled type.

On each transformer are mounted two oil-to-water heat exchangers, each being suitable for dissipating the transformer losses corresponding to 70 per cent of the rated full load capacity. Each transformer is fitted with an externally operated off-load tap changer on the high-voltage windings.

Of welded steel construction, the tanks and cover are capable of standing an internal gas pressure of 10 lb per sq. in at the top of the tank when filled with oil to normal level and, in addition, can withstand a full vacuum.

It is necessary to maintain an adequate supply of oil-pumped dry nitrogen gas under positive internal pressure in the space between the top of the oil and the tank cover. To do this fully automatic pressure-regulated inert gas equipment is provided.

In accordance with the appropriate American standards, tests were carried out on each transformer. These included loss tests, full load temperature tests, noise tests and impulse tests at 450 kV and 825 kV insulation level on the 120 and 240 kV windings respectively.

Valve for Decelerating Machinery

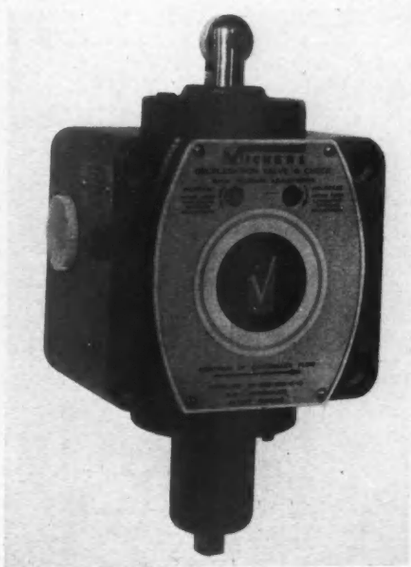
Deceleration of moving machinery or mechanical parts can present a number of problems to the designer. Not only is there a danger of generating destructive forces, but there may also be the need to control the period or distance over which this deceleration takes place.

One method of applying a braking force hydraulically is by throttling or strangling exhaust flow and this principle is used in the Vickers deceleration valve which is now manufactured by Stein Atkinson Vickers Hydraulics Limited, 197 Knightsbridge, London, SW7. The valve is placed in the exhaust flow line from the actuator. The spool on the valve is mechanically depressed by a cam and strangles the flow through the valve.

An example of a design in which this valve could be incorporated is on a planing machine. The table travelling at its maximum speed nears the end of its travel and operates a reversing valve. At the same time, a cam starts operating the deceleration valve. The exhaust-flow from the cylinder is then either passing freely through or is diverted to the deceleration valve. The pressure can thus be removed from one side of the piston at the same time as a braking pressure is being applied to the other. Momentum carries the table on and the valve is depressed further and the braking pressure rises. As the braking effect is felt, so the table slows down and the rate of flow through the valve is reduced. This reduction has the effect of reducing the pressure gradient across the valve. Regardless of the load of the table, it will be brought to rest in a distance determined by the cam in a time which is dependent on the load—the greater the load the shorter the time since the higher pressure generated will force a higher flow through the valve at any given position in its travel.

The deceleration valve is fitted with an adjustment, so that the initial pressure gradient across the valve may be set so that the full movement of the valve spool will be used in deceleration.

Performance for the valves is within the range of 4 to 50 gals per min up to 3,000 lb per sq. in.



This deceleration valve can be used in hydraulic oil systems to slow down smoothly heavy parts.

No Heat, Fumes or Noise

A MICROWAVE oven, known as the Artic oven and made by Lewispoint Holdings Limited, 18, St. George's Street, Hanover Square, London, W1, is claimed to do the work of a normal oven in one-tenth of the time. Some of the times are given in the accompanying table and with this saving in time comes a corresponding saving in electricity. The electrical rating is given as 200/250 V, 50 c/s, single phase, with a full load current at 230 V of 25 A when cooking. The electronic equipment incorporates a magnetron, which produces the radio frequency "heat" waves; four rectifiers; and one thermal delay device.

The oven is claimed not to destroy the taste of food, on the contrary this method of cooking without heat is said to improve the flavour, as the vitamins are no longer lost. Safe to operate, and with no risk of burns, the cooking process automatically ceases if the oven door is opened for examination. High efficiency is obtained as no energy can escape from the oven and there are no fumes.

When switching on from cold, there is an initial warming-up period of 90 sec, and the process timer can be set to operate at any given time

Some of the Cooking Times for the Artic Oven

Item	Cooking time
3½ lb fresh chicken	3½ min
3½ lb deep frozen chicken	5½ min
One portion of meat and two vegetables pre-cooked and deep frozen	60 sec
A plate of fresh fish	30 sec
Steak or chops (one portion)	30/40 sec

between five seconds and five minutes. Food can be cooked on a plate or even inside a packet and one of the values of the oven is that it can re-heat pre-cooked foods to the quality of freshly cooked foods very quickly. Deep frozen foods can be cooked without de-frosting.

The oven, which is said to occupy little floor space, can be styled in either stainless steel, aluminium or highly finished mild steel. It is movable, being mounted on four rubber-covered castors. As it is air cooled, it needs nothing more than a suitable mains supply, and it is said by the makers to be very simple to install.

Internally, the oven is constructed of high quality aluminium. The drop-down door has a stainless steel working surface. A clear hard-glass shelf measuring 17½ in by 15½ in is fitted 2 in from the bottom. Three removable glass shelves can be supplied as an extra. The stacking height in the oven is 9 in and the steam is drawn from the oven by a 6 in extractor fan.

Not only is the Artic oven suitable for the home it is well suited for restaurants and canteens. Hot meals can be offered at any time as the speed at which it cooks means that it is not necessary to keep kitchen staff on duty waiting for the chance customer to come in. The oven can be bought or contract hired, and the makers offer a 24 hour service to keep the oven in operating condition during the full period of hire.

The Artic Microwave oven is ideal for providing hot meals in a very short time.

The cooker described above is said not to produce any fumes, but there are still plenty about that do. In addition to fumes in a kitchen, there is heat, and all the associated smells of cooking and an extractor fan in these days can hardly be regarded as a luxury.

Jones and Stevens Limited, PO Box 35, Eastern By-Pass, Littlemore, Oxford, now manufacture what they call their Minex Super Fan which has been developed from their earlier Mark I and II models.

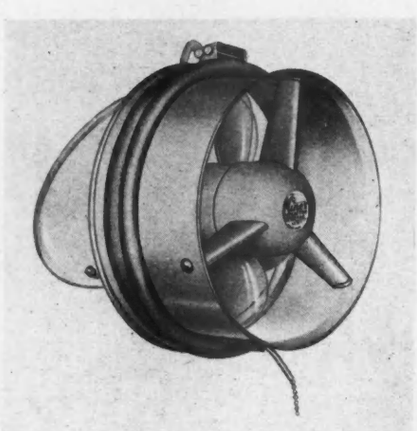
The main disadvantage of any fan is that when a propeller is revolving quickly it makes a noise as it cuts the air. This noise can be minimised by careful design of the whole unit and it is readily established that a large fan turning more slowly can move as much air, or more, than a small fan turning quickly. A small fan turning quickly gives the impression, because of the noise, that it is doing more work, but as is only too well known, this noise can be very irksome when it is constantly present.

The principal feature of this design is to provide a fan with the maximum air extraction rate but with the minimum of noise. This has been done by employing their own 40 watt, four-pole/shaded-pole motor in conjunction with an 8 in impeller. In this way the makers have been able to offer a comparatively slow speed fan (about 1,200 rpm) free from buzz but with an air extraction rate of up to 20,000 cu. ft per hour.

Larger than the previous models, it is still small enough to fit into a 9⅛ in diameter hole. The employment of alloy castings for the body of the fan, rather than plastics, emphasises the robust design. A moulded hinged and adjustable external transparent louvre is incorporated so that, the fan does not obstruct the light.

Fitted with a totally enclosed motor, the four bladed plastic fan—which is white—is a contributory factor to the quiet running. The motor characteristics are such that even when the external louvre is completely closed the unit will not overheat. A moulded rubber gasket is provided for window fitting, which makes installation simple and also eliminates the use of any screws, plates or other parts.

The Super Minex extractor fan gives good air extraction with little or no noise.



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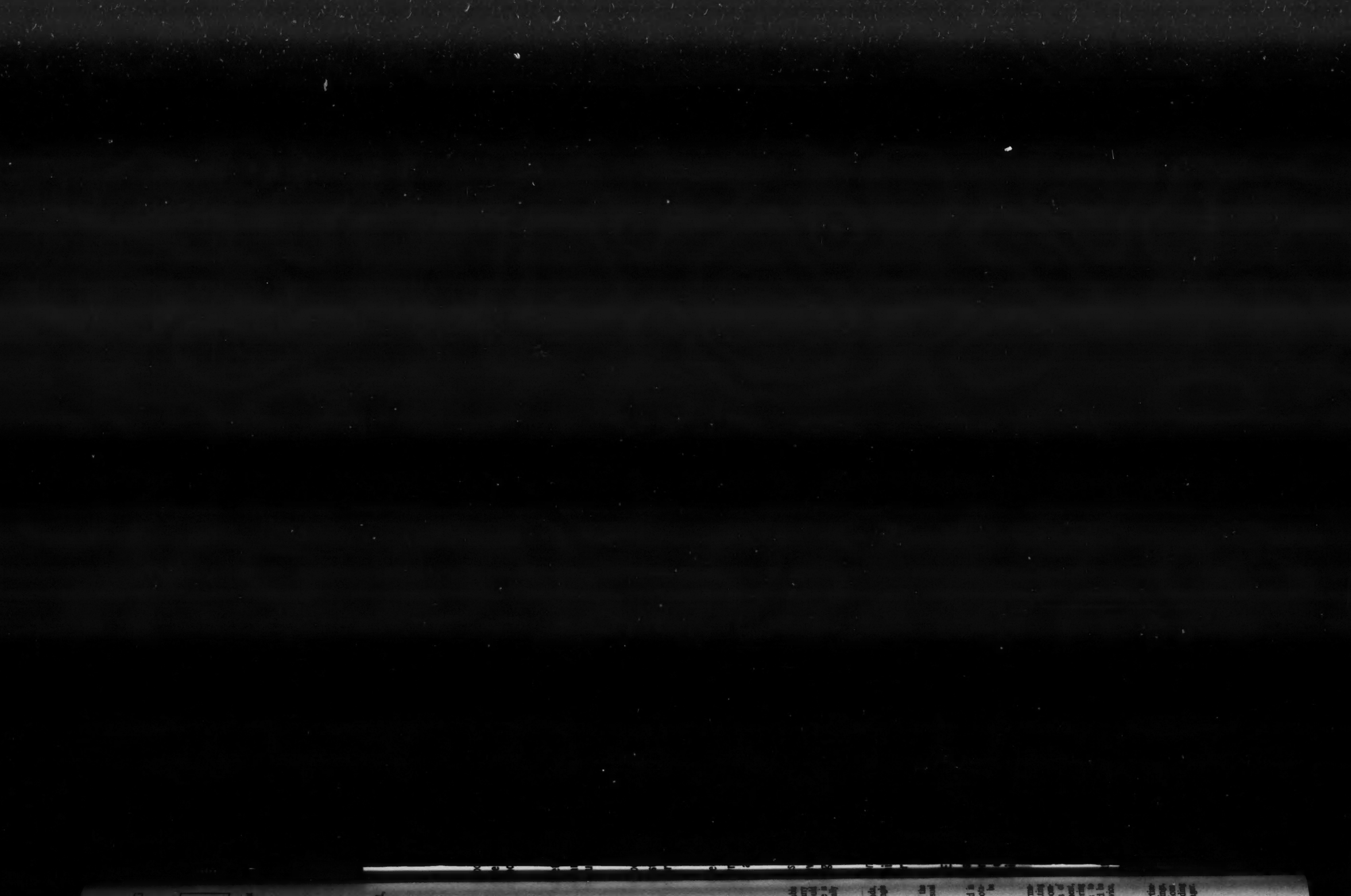
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